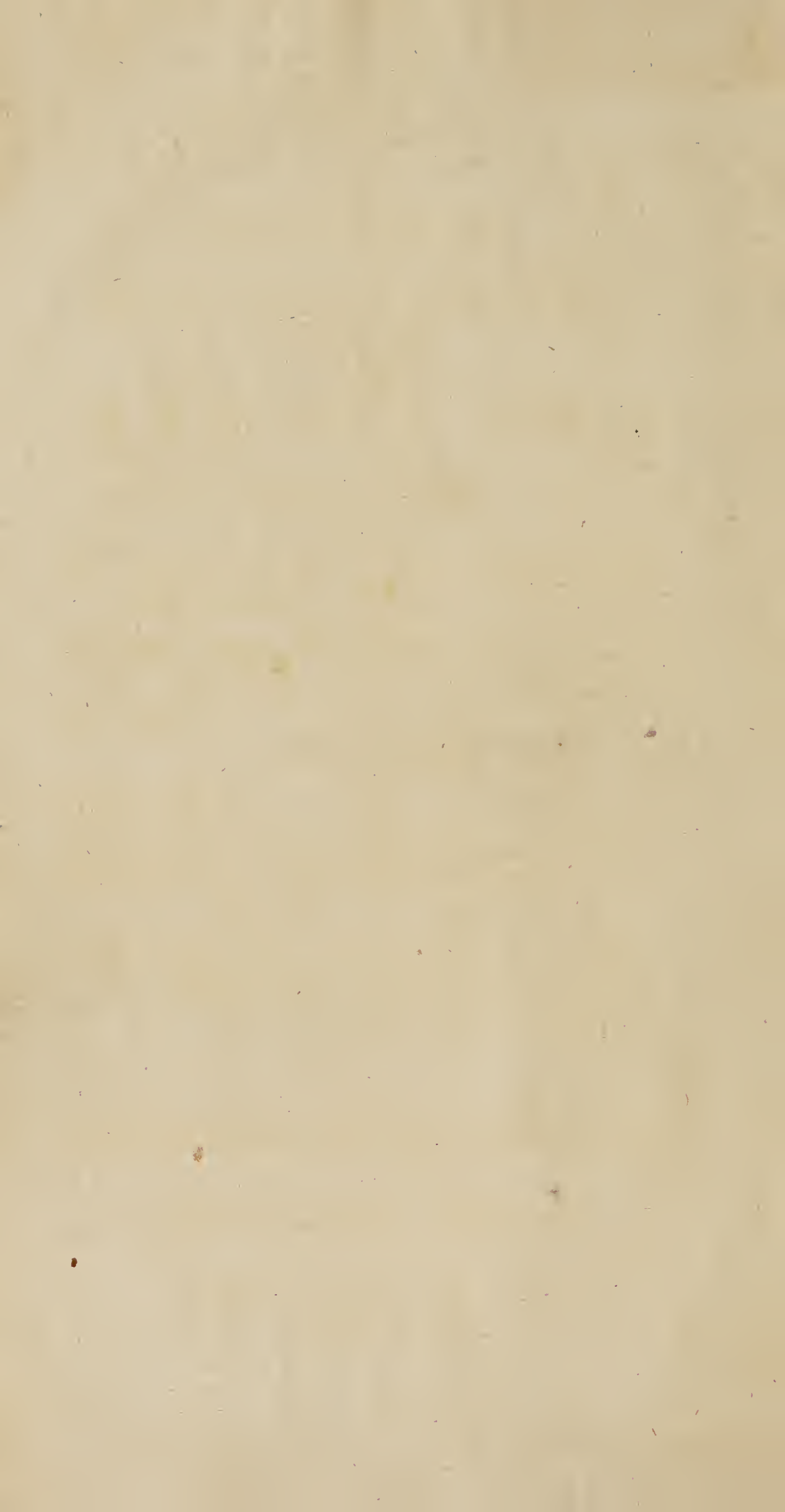




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Wm Williams
Bridge Street
1779

A

MEDICAL
COMMENTARY
ON
FIXED AIR:

PARTICULARLY,

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|--|---|
| I. On the different methods of procuring and administering Fixed Air. | VI. On the use of Fixed Air in cachexies and phagedenic ulcers. |
| II. On its sensible effects in health, taken internally. | VII. In some diseases of the stomach. |
| III. On its effects in diseases of the putrid class. | VIII. In the stone and gravel. |
| IV. On putrefaction, the putrid effluvium, and the means of correcting the putrid effluvium. | IX. On the disposition to the stone in the cyder counties, compared with some other parts of England. |
| V. On the effects of Fixed Air, on the putrefactive process, and on the putrid effluvium. | X. On the noxious effects of Fixed Air. |

B Y

MATTHEW DOBSON, M.D. F.R.S.

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M,DCC,LXXIX.



THIS
COMMENTARY,
FROM GRATITUDE AND RESPECT,
IS ADDRESSED

TO
DOCTOR JOHN FOTHERGILL, F.R.S.
AND MEMBER OF THE ROYAL SOCIETY OF
MEDICINE AT PARIS,

AND
DOCTOR WILLIAM CULLEN, F.R.S.
PROFESSOR OF MEDICINE IN THE UNIVERSITY
OF EDINBURGH, AND MEMBER OF THE ROYAL
SOCIETY OF MEDICINE AT PARIS,

LIVERPOOL,
JULY 1st, 1779.

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A
M E D I C A L
C O M M E N T A R Y
O N
F I X E D A I R.

I N T R O D U C T I O N.

FIXED Air has been found by some ingenious modern writers, to possess such singular and powerful qualities, as to become an important subject of Medical and Philosophical inquiry.

Considered as a subject of Natural Philosophy in general, Fixed Air is essential to many of the operations of Nature, and when it's various properties are still further ascertained, may lead to a clearer knowledge of some of her more abstruse and intricate movements.

B

Considered

Considered as a subject of Medical Philosophy, Fixed Air appears likewise to be of extensive importance. If we attend to the state of the animal oeconomy in health, we find it present in the stomach and intestines, as developed by the process of digestion; and we find also, from the experiments of Dr. Hales, Sir John Pringle, Dr. Macbride, and others, that Fixed Air enters very universally into the composition of animal substances. Its presence and effects are no less obvious in the diseased state of the animal oeconomy; where the stomach is weak, and the digestion consequently imperfect, it is exerted in a troublesome and oppressive flatulence, which sometimes degenerates into a confirmed Tympany. When combined with an animal earth, it forms the stone and gravel: and in mortifications, it is the same fluid, which raises the cuticle in vesications, and
encreases

increases the bulk of the diseased parts.

It might be conjectured *a priori*, that a body which has such a general influence in the animal oeconomy, might be so directed by art, as to produce very powerful effects; and we accordingly find, that Fixed Air may be rendered the instrument either of health or disease, of life or death, according to the circumstances which accompany its application. If an animal be immersed in a sufficient quantity of pure Fixed Air, a total loss of sense and motion immediately ensues; and if the animal be not speedily returned into common air, death is the certain consequence. On the other hand, Fixed Air, when properly managed, promises very salutary effects in some diseases, and may be variously adapted to the purposes of medicine.

SECTION I.

OF THE DIFFERENT METHODS OF PROCURING AND ADMINISTERING FIXED AIR.

I. Those mineral waters which are brisk and sparkling, as well as a variety of fermented liquors, are strongly impregnated with Fixed Air, and are drank with advantage on this account.

II. Common water may be artificially impregnated with Fixed Air, by different methods.

1. Water may be saturated with the Fixed Air of chalk, detached by the acid of vitriol, according to the directions given by the very ingenious Dr. Priestley. (a)

2. Water may likewise be impregnated with Fixed Air, by the assistance of Dr. Nooth's elegant glass apparatus.

3. Dr.

(a) Directions for impregnating water, &c. by Joseph Priestley, L.L.D. F.R.S.

3. Dr. Priestley mentions another method of saturating water with Fixed Air, which is to take two vessels, and to keep pouring the water from one into the other, when they are both of them held as near as possible to the yeast of some fermenting liquor. “In this manner,” says the Doctor, “I have sometimes, in the space of two or three minutes, made a glass of exceedingly pleasant sparkling water, which could hardly be distinguished from very good Pyrmont, or rather Seltzer water.” (b)

4. The Duke de Chaulnes proposes a method also of expeditiously saturating large quantities of water, with the Fixed Air which is accumulated on the surface of fermenting liquors. A vessel, containing eight or ten gallons of water, is to be let down and suspended near the surface of the fermenting liquor; and the water is then to be powerfully agitated

(b) Experiments on Air, vol. 1, p. 28.

tated by a contrivance resembling the mill of a chocolate-pot. The Duke finds that thirty or forty pints of water may, in one minute, thus be saturated with Fixed Air. (*c*)

5. M. Venel, late Professor of Chemistry in the University of Montpellier, contrived, many years ago, a still different process for impregnating water with Fixed Air. By this process the Fixed Air is transferred in a quiescent state from the alkaline salt, and passes without any sensible effervescence into water, or any other fluid in which the alkali has been previously dissolved. That this process may succeed, it is necessary that both the acid and alkali be sufficiently diluted, that they be mixed cautiously, and the vessel immediately well corked. (*d*) The particulars of this

(*c*) Journal de Physique.

(*d*) It is to be observed that M. Venel supposes the elastic fluid contained in mineral waters to be common atmospheric air.

this process may be seen at large in two memoirs read before the Royal Academy of Sciences in 1750, and published in the second volume of *Mémoires présentés par les Sçavans étrangers*. Or in Mr. Henry's translation of M. Lavoisier's *Essays Physical and Chemical*,

The nature of this volatile principle in mineral waters, and the artificial means of impregnating common water with Fixed Air, so as to imitate these mineral waters, form a curious and entertaining subject, which has been gradually unfolded and explained, by Van Helmont, Hoffman, Hales, Seyp, Vernel, Brownrigg, Black, Cavendish, Lane, Priestley, Bewly, &c.

A distinguish'd modern chemist, the translator and improver of *Macquer's Chemical Dictionary*, observes, that *Van Helmont* long ago ascribed the acidulous taste and the solution of iron, in
mineral

mineral waters, to their *Gas* or Fixed Air. “ Mr. *Lane*, says he, has shewn that the *Gas* of mineral waters is capable of *dissolving iron* ; and that by means of this fluid, without any other menstruum, the iron is dissolved and suspended in many chalybeate waters. And indeed *Van Helmont*, long before, knew that the escape of the spirituous gas from these waters, by exposure to air, was accompanied with a loss of their acidulous quality, and a deposition of the ferruginous matter dissolved in them.” *Appendix to the second edition of Macquer’s Dictionary of Chemistry*, page 48.

A more accurate knowledge however of this subject is attributed to *Van Helmont* than is to be deduced from his works ; as will appear from the perusal of his *Paradoxa de Aquis Spadanis*, and his *Tractatus de Lithiasi*.

The

The writings of *Van Helmont* may not at this time be very generally read, the following abstract therefore of his account of the German Spaw waters, may not be unacceptable to the reader.

Van Helmont describes three volatile principles in these waters. 1. *The Spiritus sulphureus.* 2. *The Vena Ferri.* 3. *The Gas sylvestre.*

Spadani fontes habent spiritum sulphureum, manifeste acidum, unde fontes acidi dicuntur, et venam ferri. Utrumque nempe embryonatum, immaturumque continetur liquatum, in aqua simplici. Lithiasis, Caput quartum, § 3.

Both these principles are volatile; the first, the *spiritus sulphureus*, he likewise calls *sal esurinum*, *sulphuris embryo*, and under these names clearly describes the volatile vitriolic acid, to which he attributes the *acidulous taste* of these

C

waters.

waters. The *vena ferri* or metallic principle is likewise volatile, and is called sometimes *vena volatilis*, *venæ embryo*.

As long as these two principles remain distinct, the waters retain their virtue and activity; but as soon as they are combined, they form a third substance, which adheres to the vessels in the form of an ocherous or stony crust, and the waters become effete.

Mox itaque incipiunt ambo vires reciprocas in se mutuo conferere, Atque tandem, cum lassatis viribus, stiterint actionem suam, condensantur in corpus lapideum, lagenis se affigens, in forma ocræ; sicque aqua redit in pristinum elementum, omni exuta qualitate aliena. Lithiasis, Caput quartum, § 4.

The formation of the ochre from these two volatile principles, is likewise described in the following words. *Estque longe alia prorsus actio, dum duo spiri-*
tus

tus in se invicem agunt. Nam in hac constituitur novum ac neutrum ens, qualis est ocra, ex spiritu sulfuris, et venæ volatilis. Ibidem, § 5.

The *Gas* or third volatile principle, is separated during the conflict of these two; and the entire separation of the *Gas*, is only a mark of their complete union. If the waters are kept close, the *Gas* does not escape, the two principles are prevented from acting on each other, and the waters consequently retain their virtues. *Verum spadaneæ spiritus acidi, ex embryonato sulphure enati, bullas atque silvestre gas excitant, ac tandem se vasi affigunt. Alioquin enim si istud Gas nequeat eruētari, aquæ spadaneæ manent sospites, medendo aptæ. Nam si Gas egredi prohibeatur, impedit, quo minus subsequens sequatur, spiritusque reddantur effecti agendo. Lithiasis Cap. quartum, § 7.*

With respect to the medicinal virtues

of these waters, *Van Helmont* ascribes their deobstruent qualities to the *sal esurinum*, and their strengthening powers to the *vena ferri* or metallic principle: (e) but no virtues are attributed to the Gas or Fixed Air, except that of being a test, by which we discover, when the *sal esurinum* and *vena ferri* are perfectly united; and their medicinal virtues consequently exhausted by their action on each other. The reader will easily distinguish, how ingenious, fanciful, and erroneous, is this account of the German Spaw waters.

III. Another method of adapting Fixed Air to the purposes of medicine, is by the addition of lemon juice to salt of tartar, salt of wormwood, or any other fixed alkaline salt; the mixture being instantly drank as soon as the effervescence commences. This remedy

(e) Paradoxum quintum, § 1. & 7.]

medy was directed by Riverius in the nausea and vomitings of malignant fevers, to the great refreshment and relief of the patient. (*f*) It does not appear, however, that Riverius attributed this happy effect to the Fixed Air, or that he was at all acquainted with the subject.

IV. Fixed Air may in like manner be given as detached from the volatile alkali by lemon juice; and thus administered, has the advantage of being combined with a very palatable *Spiritus Mindereri*, a medicine of well-known efficacy.

V. Dr. Macbride, in his very valuable and ingenious essays, has suggested another mode of administering Fixed Air. Wort, ripe fruits, or any kind of saccharine substance, received into the alimentary canal, soon pass into a state

(*f*) *Praxis medica*. lib. 9, cap. 7.

state of fermentation: and during this process, the Fixed Air is separated and may answer many useful medicinal purposes.

Under this idea, Dr. Macbride has strongly recommended *wort*, as a very efficacious remedy in the *sea scurvy*.

VI. The ingenious Mr. Bewly, has proved by a series of well imagined and decisive experiments, that Fixed Air is an *Acid*; that alkalies may be saturated and perfectly neutralised by this acid; and that its having a weaker affinity with the alkali than any of the other acids, affords a powerful and commodious way of exhibiting Fixed Air. (g)

The alkaline salt previously dissolved in water, may be easily saturated with Fixed Air in Dr. Nooth's apparatus; and

(g) See Mr. Bewly's letters in the appendix to the 2d vol. of Dr. Priestley's *Experim. and Observ. on Air*.

and I generally direct the patient to drink an ounce of this medicated water, containing one scruple of alkaline salt, a tea-spoonful of any spirituous water, and a little syrup; and to wash it down with a large spoonful of lemon juice, made into lemonade with sugar and water.

VII. Clysters of Fixed Air have been recommended by Dr. Priestley in putrid fevers; and in consequence of this hint, Mr. Hey of Leeds was happily instrumental in the recovery of a young gentleman from a dangerous fever of this kind, accompanied with a putrid *diarrhæa*. (*b*)

This practice has been adopted by Dr. Warren, of Taunton; and also by my ingenious friend Dr. Percival, who has been very benevolently attentive to the medical uses of Fixed Air.

VIII. Fixed

(*b*) See Mr. Hey's letter to Dr. Priestley, appendix to vol. 1, page 292.

VIII. Fixed Air may also be externally applied, either by a proper apparatus determining it upon the diseased parts, or by mixing it with the air of the chamber so as to be freely and constantly respired. (*i*)

Is it not probable that the carrot poultice, or any other sweet vegetable substance, applied in this form, owe their efficacy to the detachment of the Fixed Air during the application of the poultice?

Such are some of the various methods in which Fixed Air may be administered as a medicine. To determine the different proportions of Fixed Air contained in chalk and the fixed and volatile alkalies, which are the substances most commonly directed for the supply of Fixed Air, I made the following experiments.

EXPERIMENT

(*i*) Dr. Rotheram's letter to Dr. Percival, Med. and Exp. Essays, vol. 3d.

EXPERIMENT I.

Two drams of powdered and well-dried chalk were put into a twenty-ounce vial, and to this were added three ounces of water: the vial, chalk, and water, weighed exactly nine ounces, six drams, and one scruple. As much acid of vitriol diluted with water was then added, as was sufficient to separate the whole of the Fixed Air of the chalk; which was effected by one ounce, one scruple, and twelve grains of the dilute acid. The vial, with it's contents, now weighed ten ounces, six drams, and ten grains. Two scruples therefore, and two grains of Fixed Air, had been separated from this quantity of chalk by the addition of the acid.

EXPERIMENT II.

Two drams of dry and pure salt of tartar, managed as in the preceding experiment, yielded one scruple and eight

D grains

grains of Fixed Air. The result of this experiment corresponds with a similar one made by the accurate and ingenious Professor Black. (*k*)

EXPERIMENT III.

Two drams of volatile sal ammoniac carefully treated as in the first experiment, gave two scruples and eight grains of Fixed Air.

It appears, therefore, from these experiments, that two drams of each of these substances contain the following proportions of Fixed Air.

VOLATILE SAL AMMONIAC,	48 grains.
CHALK, - - -	42 grains.
SALT OF TARTAR, - -	28 grains.

In the above experiments, some small portion of water, or other heterogeneous matter, might rise together with the

(*k*) *Essays Physic. and Literary*, vol. 2, p. 177.

the Fixed Air. To prevent this, however, a very tall vial was used, the acid added slowly, and the vial lightly cork'd during the effervescence.

SECTION II.

Of the sensible effects of Fixed Air in Health, taken internally.

Pyrmont and other mineral waters which are strongly impregnated with Fixed Air, when drank in their full vigour as immediately drawn from the spring, have a very sensible effect on the brain and nervous system; they raise the spirits, diffuse an agreeable glow through the whole body, quicken the pulse, and often excite a vertigo and temporary intoxication. To determine whether Fixed Air, as procured by art for medicinal uses, had similar effects, I made the following experiments.

EXPERIMENT I.

One scruple of salt of tartar dissolved in a large spoonful of water with a little sugar, and drank instantly on being mixed with half an ounce of lemon juice, had little sensible effect, except that it quickened the pulse three or four strokes in a minute for about ten minutes. Half a scruple of volatile sal ammoniac, taken in the same manner, with half an ounce of lemon juice, had nearly the same effects.

EXPERIMENT II.

Two scruples and three grains of salt of tartar, a quantity which yields ten grains of Fixed Air, were dissolved in half an ounce of water; to this was added rather more than an ounce of lemon juice, and instantly drank as the effervescence commenced. The natural state of the pulse, at this time, was 71. The effects of the mixture on the pulse were

In

In 5 minutes	-	-	74
10	-	-	77
15	-	-	76
20	-	-	73
30	-	-	71

Immediately on drinking the mixture, there was an agreeable sensation in the stomach, with a slight glow and a slight degree of vertigo, which continued for about twelve minutes.

After the pulse had returned to the natural state, the same mixture was repeated, and with the following effects.

In 5 minutes	-	-	74
10	-	-	77
15	-	-	80
20	-	-	75
30	-	-	74
40	-	-	73
60	-	-	71

The vertigo was flighter, but continued longer; there was likewise a slight degree of nausea, and the pulse was somewhat smaller for 15 minutes, than after the former dose. It acted as a diuretic; but this effect might proceed from the neutral salt of the mixture, as well as from the Fixed Air.

From these experiments we learn, that the Fixed Air of salt of tartar acts as a gentle stimulus on the stomach, extends its influence to the brain and nervous system, and quickens the action of the heart and arteries. We likewise learn, that eight or ten grains of this kind of Fixed Air, is as large a dose as can be exhibited, without producing a considerable degree of nausea.

EXPERIMENT III.

One scruple and five grains of volatile sal ammoniac, a quantity which gives ten grains of Fixed Air, drank
with

with a full ounce of lemon juice, produced nearly the same effects with the Fixed Air of the salt of tartar in the preceding experiment ; with this difference only, that instead of the glow, it excited an agreeable sense of coolness in the stomach.

SECTION III.

Of the effects of FIXED AIR in diseases of the putrid class.

§ I. PUTRID FEVERS.

Putrid fevers rarely acquire any great degree of malignancy in Liverpool, or it's neighbourhood ; and when they do appear, it is generally among the lower ranks of people. A fever of this kind crept into our public hospital in the spring of the year 1773, and a considerable number were infected.

The following cases are transcribed from the notes, which were taken during

during my attendance on the respective patients.

CASE I. (1)

Mary Rainford, about 15 years of age, was admitted into the hospital on account of convulsions; she was subject likewise every three or four weeks to vomit large quantities of blood, and was much enfeebled by these complaints at the time of her being seized with the fever.

She first complained of pain and weight in the head, pain in the limbs and back, and a great degree of languor and dejection; she had frequent chills alternating with flushes of heat, and got very little rest. The *tartar emetic* was given, and operated easily and powerfully by vomit; a blister was applied between the shoulders; and an ounce

(1) The three subsequent Cases were published in the Appendix to the 2d vol. of Dr. Priestley's *Exper. and Observ.*

ounce of *spiritus mindereri*, made agreeable to the palate with a little sugar and compound spirit of lavender, was ordered to be taken every three hours.

She had for common drink, lemonade with sweet mountain, or barley-water well acidulated; the body was kept soluble either by clysters, or some gentle purgative, and the room was well aired by opening the door and windows. But notwithstanding the steady use of these means, the fever became more and more untoward, and was on the sixth day accompanied with such dangerous symptoms, as made it necessary to adopt some other method. The eyes were heavy, the *conjunctiva* red, large *petechiæ* spread over different parts of the body, the tongue was covered with a brown fur, and the teeth with a fur of a blackish colour; she was very feeble, got no sleep, and was frequently delirious, especially during

E the

the night. Hitherto the state of the pulse had been about 120, now it was 135, and very weak.

One scruple of salt of tartar and one scruple of sugar dissolved in half an ounce of water, and half an ounce of lemon juice, were given every hour in the state of effervescence. The patient took no other medicine, the symptoms became more favourable, and she was out of danger in four days.

CASE II.

Alice Rigby was received into the hospital for a fore leg, and during her stay was attacked with the fever of the house. The progress and treatment of the disease for the first week, were nearly the same as in the preceding case. On the seventh day she was extremely weak, got no rest; there were large *petechiæ* on many parts of the body, the brain was
much

much affected, pulse 125, and the tongue little differing from the natural state.

Fixed Air was now administered in the same manner as to the former patient. The *petechiæ* soon began to disappear, she got strength, the pulse became fuller and slower, and the fever was in six days entirely removed. The bark was at this time ordered, as an additional security against a relapse.

CASE III.

March 20. A consultation was desir'd for Ann Knowles, who had been in the hospital for a considerable time, and was much reduced by a long continued rheumatism at the time she was attacked with the fever. This was the seventh day of the disease; and though she had been very judiciously treated by the gentleman under whose care she had been at first admitted, the fever grew

daily worſe, and was now accompanied with many dangerous ſymptoms.

I obſerved an extreme languor and dejection; the eyes heavy, the eye-lids half cloſed, and the *conjunctiva* inflamed. There was a ſtupor, with a muttering kind of delirium, and a continual toſſing and moaning. The pulse very weak and very frequent, more than 140 in a minute; the tongue moiſt and clear, and not altered from it's natural appearance, except that it was of a deep red. The whole body was covered with ſmall *petechiæ*; ſhe had frequent ſtools, which were extremely offensive, and her little remains of ſtrength were every hour ſtill more and more exhausted.

It was agreed that ſhe ſhould take the Fixed Air in the ſame way I had ordered it for the two preceding patients.

March 21. The good effects of this
medicine

medicine were evident, though the symptoms were still urgent and alarming: the stools less frequent, but offensive; the pulse 130, and not so languid: in other respects the patient was not much altered.

23. The *petechiæ* disappearing, the looseness diminished, and the stools much less offensive; pulse 110; sleeps and gets strength. The medicine was now to be given only every four hours.

24. Stronger and better, pulse 100, head much clearer, and the tongue has more of it's natural red.

26. Pulse 85; and from this time the fever entirely left her. She took no other medicine, and had no relapse.

I have directed Fixed Air, both in hospital and private practice, for a variety of patients, in fevers attended
with

with symptoms of putrefaction, and with success. It would be superfluous to enter into a numerous detail of particular histories; I shall only therefore relate one instance more of the happy effects of Fixed Air in putrid fevers, and in which the fever was accompanied with a very alarming putrid *diarrhœa*.

CASE IV.

December 1772, Mr. Birdfall, of Ormond-street, Liverpool, on the nineteenth day of a fever, to which there had been an imperfect crisis on the fourteenth, began to be restless, and complained of great pains in the bowels, which were soon accompanied with frequent loose stools of a greyish black colour, extremely offensive, and joined with an almost constant *tenesmus*. These painful evacuations continued to be very frequent for 30 hours, but without diminishing the fever or giving the least

least relief to the patient ; on the contrary, the strength was much exhausted, and the heat, thirst, and frequency of the pulse much increased ; there was an inexpressible languor, restlessness and anxiety, and the danger was great and immediate.

In this very urgent situation, it was necessary as expeditiously as possible to correct the putrid ferment, check the evacuations, and relieve the constant and painful *tenesmus*.

One scruple of salt of tartar, and the same quantity of sugar dissolved in half an ounce of water, and half an ounce of lemon juice, were given every hour in the state of effervescence. After four doses, the pains were much abated, the putrid ferment corrected, and the evacuations less frequent and less offensive.

The medicine was now given every
third

third hour ; and in thirty hours, this train of alarming symptoms was at an end ; and the patient recovered without any further difficulty.

In cases similar to this, should the *tenesmus* remain after the putrid ferment is corrected, an opiate restraining clyster might be administered with safety and advantage.

It appears from the preceding histories, that Fixed Air is a powerful antiseptic ; that it is a medicine of considerable efficacy in putrid fevers ; and that by correcting acrimony, it raises the pulse and diminishes the frequency. It likewise appears from the last case, that in fevers accompanied with a putrid *diarrhæa*, Fixed Air, as obtained from salt of tartar by giving it with lemon juice in a state of effervescence, is equally efficacious, and may be more easily and expeditiously administered than by clyster.

§ 2. *Small-pox and Measles attended with symptoms of malignancy.*

The secondary fever in the small-pox is often accompanied with dangerous symptoms of the putrid kind, and is a source of great mortality in this very fatal disease. The learned Dr. Freind recommends the free use of purgatives as soon as the pustules begin to crust, and during the continuance of the fever. (*m*) I have often experienced the good effects of this judicious practice; and have generally also at the same time, given wine liberally, both as an antiseptic, and as particularly useful in supporting the strength of the patient, during the copious evacuations produced by the purgatives.

I have likewise found Fixed Air a medicine of singular efficacy in this stage of the small-pox; and have se-

(*m*) Johannes Freind *de purgantibus* in secunda variolarum confluentium febre, &c.

lected the following history from a number of others, in which Fixed Air was given with advantage.

CASE V.

Ann Forbes, servant to Mr. Hume, of York-street, Liverpool, had the *confluent small-pox* in August 1773. The weather was extremely hot, and the symptoms so very unfavourable, that there did not appear the most distant hope of her recovery. Particular care was taken to have a constant supply of fresh air, and the antiphlogistic treatment was strictly pursued during the inflammatory fever. The disease was now advancing into the putrid stage, and the second fever commenced with little or no appearance of suppuration.

Notwithstanding every precaution with respect to the free access of air, change of linen, and every circumstance of cleanliness, the unlimited use of oranges, lemonade

lemonade and wine negus, this poor creature was the most miserable object I ever beheld. She became extremely offensive, and had the appearance of one continued mass of *putrid ichor*; the pulse small and rapid, and she had a constant restlessness with inexpressible anxiety.

A purgative was directed, and a glass of sweet mountain after every stool. The symptoms however became more alarming, the offensiveness was almost intolerable, and she was frequently sick, agitated, trembling, and like one about to expire. In this urgent situation, I determined to try the effects of Fixed Air, and it was given in the manner already mentioned.

The nurse and attendants soon observed an agreeable change. In 24 hours the putrid stench was much diminished, the breath of the patient was not near

offensive, and the chamber was very tolerable compared with what it had hitherto been. In two days more she was still much better; and by repeating the purgative, giving wine occasionally, and persevering in the use of Fixed Air, her recovery was surprisingly speedy and perfect.

When the patient has been so young as to render it impracticable to give the salt of tartar and lemon juice, I have directed the naked body to be held over an effervescing mixture, or a stream of Fixed Air to be applied successively to different parts of the body, and by the use of these means, have found the putrid symptoms powerfully corrected.

For the two following cases, I am indebted to my ingenious friend Dr. Haygarth, of Chester, an accurate and judicious observer both of the nature
of

of diseases, and of the effects of medicines.

C A S E VI.

On March 21, 1776, at ten in the morning, I was desired to visit Master Davies, a year and a half old, in the small-pox. It was the 6th day of the fever, and 4th of the eruption; the pustules were numerous, but distinct: he had a looseness, but no alarming symptom, except two large black pustules on his loins. The next morning there were ten, that evening twenty, and the following morning, which was the 8th, I reckoned thirty black pustules, of different sizes, on his hips and loins.

On my first seeing the patient, I ordered him to take every three hours, an ounce of an *aqua mephitica alkalina*, which contained a scruple of salt of tartar, supersaturated with Fixed Air,
and

and sufficiently sweetened ; and immediately after this, half an ounce of lemon juice made palatable with syrup of oranges. He was also directed to drink plentifully of malt tea. After the 8th day, when these medicines had been taken 36 hours, no more black spots appeared, tho' the medicine was then omitted from the neglect of the nurse.

On the 16th day, when the small-pox were falling off, twenty of the above-mentioned black pustules were converted into as many ulcers of various sizes on his hips and loins. In seven of these, round columns of black mortified flesh still remained ; the largest of which were half an inch in perpendicular depth, and about three-fourths of an inch in circumference at top, and broader at bottom. They were separated on all sides from the cylindrical ulcers which contained them, some
of

of which appeared to be two inches in circumference.

I now ordered the alkaline salt in the proportion above described, to be dissolved in a cold infusion of peruvian bark instead of water, and which was made not unpalatable by the Fixed Air and fyrup. An ounce was taken punctually every four hours, and a proportional quantity of the lemon juice julep was drank immediately after it. All the mortified sloughs soon separated, and the ulcers soon healed.

C A S E VII.

Master R. M. two years old, after an indisposition of two months, denoted by want of appetite, restless, hot nights, wan complexion, and sunk eyes, was seized with sneezing, a cough, a fever, and an eruption which appeared to be the measles. During this illness, he was vomited at three different times with
emetic

emetic tartar, and always with manifest advantage in relieving his breath, cough, and fever; he took two gentle purges during the eruption, and two after; but was never bled.

On May 22, 1776, six days after the eruption disappeared, there came on his legs, thighs, hips, back and arms, a great number of broad livid spots under the skin, some of them as large as the palm of the hand. Four days before, innumerable small purple spots, like old flea-bites, were seen on all parts of his body. A small ulcer had been observed some time in one corner of his mouth, which became gradually worse, and now (May 22) appeared like a large black mortified flough, surrounded with a considerable swelling of the lips, and adjoining cheek; the lips bled frequently. On this day, a large black spot appeared on the chin, which spouted out blood from various points;

points; and became a black scab, three or more inches in circumference. He had also the chincough.

In these circumstances, gr. iv. of fixed alkali, supersaturated with Fixed Air, were taken in half an ounce of water every two or three hours, and a draught of lemonade after each dose. Three days after, gr. vi. of alkali were given every two hours. These orders were executed so punctually, that 240 grains or half an ounce of the alkaline salt had been taken in six days. At which time, May 28, both the livid and purple spots had nearly vanished; the lips were greatly advanced in a healing state; the chin had a dry scab, which dropped off two days after, and left nearly a whole skin; neither his lips nor chin had bled for two days. His appetite was good, except during some feverish accessions which returned irregularly. In every other respect he gra-

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dually

dually recovered, except the chincough, which daily increased ; but this disease also ceased in a few weeks.

The Dr. suggests, from this case, as far as a single case can give instruction, that Fixed Air might probably be an useful remedy in the epidemical putrid measles, a distemper lately described in a masterly manner by his learned friend Dr. Watson, in the London Medical Inquiries.

The following is an extract also from one of Dr. Haygarth's letters, written in December, 1777.---“ I think myself much obliged to you, for suggesting the use of Fixed Air as an antiseptic in the small pox. To a patient in a bad confluent kind, I ordered the alkaline and acid juleps ; and the child's mother, who was not told what effect the medicine was intended to have, presently remarked that it had made the
breath

breath much sweeter, I cannot so far flatter myself as to think that it will prevent the second fever; but I assure you, much beyond my hopes, this patient had scarcely any signs of it. On the 11th, 12th, and 14th days of the disease, her pulse beat no more, when I reckoned them, than from 72 to 80, tho' she is only five years old. She afterwards was hot occasionally for a short time; and on the 16th, her pulse was 100, which was the most frequent I ever felt it, during this stage of the disease."

Extract of a letter from Mr. Sandbach
to Dr. Haygarth.

"The small-pox patient you attended (viz. Master D-----) was in a truly alarming situation. You may remember a number of the pustules on the breech became gangrenous and formed pretty deep eschars, the discharge from which was very considerable and very
G 2 offensive,

offensive, the child extremely feverish and much emaciated.

“ In two days after taking the infus. per. alkan. meph. and acid julep, the feverish symptoms abated, the discharge was somewhat diminished, the gangrenes put on a more favourable aspect, and the eschars soon after separated.

“ The extraordinary good effects of this medicine in the above case, induced me to make trial of it in the following one :

C A S E VIII.

“ Sept. 5th, 1777, I was called to a young man (19 years of age) labouring under the confluent small-pox. It was the 11th day of the disease from the eruption, he had taken no medicines except what had been administer'd by an old nurse, under whose management he had been the whole of his illness.

ness. She had, I believe, kept him very warm, and shut out as much as possible all communication of external air, that of the room was exceeding offensive; the patient's face was covered almost entirely with a dark-coloured scab, petechiæ were observable on many parts of the body of a livid hue, a number of the pustules on the arms, legs and body, had run together and formed large bladders, some the size of a crown piece, fill'd with a dark-coloured serum; the pulse was extremely quick and small, the tongue dry and black, great restlessness, subsultus tendinum, with some degree of delirium. Under these circumstances I had little to expect from medicines of any kind; I however ordered him the infus. per. alk. meph. and acid julep.

“ Sept. 6. Fever much abated, patient less delirious, several of the bladders had burst during the night; every symptom

tom more favourable.---From this time he grew daily better ; he continued the use of the medicines till the 19th inst. without any complaint intervening, except a tickling cough, which soon left him ; he remain'd in a feeble state some time.

“ I have frequently given the above medicine in ill-conditioned ulcers and abscesses happening after the small-pox, with great advantage, where there has been every reason to dread an approaching hectic.”

§. III. GANGRENE.

In the three last cases which have been related, and in which there was a strong gangrenous disposition, Fixed Air was given with evident good effect : and my friend Dr. Percival has favour'd me with the following history of a *mortification of the leg*, in which Fixed Air
was

was administered, after other powerful medicines had been tried in vain.

CASE IX.

Mr. O---, aged about 60 years, of a gross habit and with a short neck, had been long subject to an humoral asthma. His difficulty of breathing having increased very much, I was called to his assistance April 6, 1777. From his bloated countenance, oppressed pulse, great breathlessness, diminished secretion of urine, and from a slight swelling of his legs, I immediately apprehended that he laboured under an *anasarca* of the lungs. A blister between the shoulders had been applied by Mr. Henry his apothecary, who had likewise administered several active remedies.

Purgatives, expectorants, and diuretics were tried till April 18, but without any apparent good effect. The
patient's

patient's countenance was now livid, his pulse scarcely perceptible; his breathing very laborious; and he was generally asleep, unless roused by his attendants. Orders were given to apply blisters to each leg; and to take every four hours a draught, the chief ingredients of which were oxymel of squills, dulcified spirit of nitre, and compound juniper water.

April 19. The blisters had discharged an extraordinary quantity of *serum*, and the patient had voided several pints of urine. His breathing was now tolerably easy; his expectoration copious; the drowfiness had left him; and he had almost recovered his natural countenance and complexion. These favourable symptoms continued till the 27th, when a violent *Erysipelatous* inflammation came on both his legs, and the succeeding day a *mortification* appeared, and spread rapidly on the outside of
one

one of them, opposite to the part which had been blistered. I was at this time absent from Manchester; and Mr. White was called to the assistance of my patient. He scarified the leg, applied the usual dressings to it, and directed the common fomentation, with camphorated spirit of wine; and a saline draught, with tincture of bark, to be taken every three hours.

April 30. I found the patient in the circumstances above described, with a quick and hard pulse, dry skin, and other symptoms of fever. The mortification was enlarging itself every way, and the lividness extended to the middle of the thigh. V. S. was directed; and a scruple of nitre, with 15 grains of cicuta, were given every four or five hours.

May 1. Every appearance was more unfavourable; and the case of our patient

H

tient

patient seemed, both to Mr. White and to myself, to be desperate. I suggested the trial of Fixed Air; and prescribed half a dram of salt of wormwood, with a sufficient quantity of the juice of lemons, to be taken in the state of effervescence every two hours; hoping that this remedy might act as an antiseptic, febrifuge, and diuretic. The patient was also desired to drink freely of *seltzer-water*.

May 2. The fever was abated, the progress of the mortification checked, and the putrid stench corrected.

May 3. The sores began to discharge good matter; sensibility was restored to the whole leg and thigh; fresh granulations succeeded; and the parts from this time healed slowly and kindly. The internal use of Fixed Air was continued about a fortnight.

Mr.

Mr. Power, of Polesworth, successfully treated two cases of mortification with fermenting cataplasms. Flower, honey, and water, were mixed into a paste, set by the fire till they began to ferment, and then applied to the parts affected. (o)

§ 4. *Ulcerous sore-throat.*

The ulcerous fore-throat occurs more frequently, but appears to be less malignant than it was about the middle of the present century, when Dr. Fothergill published his excellent observations on this disease. The fever however is sometimes still malignant, and the ulcerated parts disposed to degenerate into the gangrenous state. When this is the case, the most powerful antiseptics are indicated, and tho' assiduously administered both internally and externally, they are too often insufficient to check the progress of the disease.

(o) Medical Transactions, vol. III.

Mr. White, in his valuable *Treatise on the Management of Pregnant and Lying-in Women*, observes, that much advantage has been derived from fumi-gating the ulcers with Fixed Air: (p) and Mr. Henry removed a very large and deep slough in the putrid fore throat, and healed the ulcer more expeditiously by the inspiration of Fixed Air, than by any other method. (q) I have likewise experienced the same good effects from Fixed Air, as detached in the effervescing draughts made with salt of tartar and lemon juice, and repeating the dose every two or three hours. Fixed Air, thus administered, acts both as a topical and general remedy; it checks the putrid fever, and brings the ulcerated parts into a benign and healing condition.

I have

(p) p. 182, second edition.

(q) See Mr. Henry's ingenious Experiments and Observations, &c. p. 127.

I have just received the following intelligence on this subject from Dr. Haygarth. "In a late instance, the respiring of Fixed Air, detached from chalk by the vitriolic acid, seemed remarkably efficacious in removing and in preventing the regeneration of a *black sordes*, that had covered the fauces, roof of the mouth, tongue and teeth, in a fever that had many other symptoms which denoted an uncommon degree of putrefaction. This putrid fever had been preceded by an ulcerous sore throat, and a violent Phrenitis. In two other putrid fevers that have since occurred, the respiration of Fixed Air appeared very beneficial in removing this *black sordes* from the mouth."

The same Physician sent me the following.

C A S E X.

"I had lately a patient, on whom Fixed Air seemed to have a remarkably
good

good effect. A boy five years old, three weeks before I saw him, had been attacked by an ulcerous fore-throat, and scarlet fever, during which I believe he had taken few or no antiseptic remedies. I was consulted for various ailments which were the consequence of these diseases, and appeared to proceed from a *dissolved state of the blood*. During the fortnight before I saw him, he had frequent hæmorrhages from the nose. His urine was in sufficient quantity, and yet contained a sediment which was in bulk equal to a third part of the whole. The urine while warm was very red, and the sediment, on dropping, was of a dark brown or rather black colour. These circumstances denoted that it contained a considerable admixture of blood. He had large, frequent, liquid stools. There was a copious serous effusion into most of the cavities of the body; his belly was increased four or five inches in circumference, and

and a fluctation was perceivable on percussion; he had great difficulty in breathing, which was remarkably increased on the least motion, when falling asleep he was frequently roused with a sense of immediate suffocation; he was anasarcaous from head to foot.

“ Various remedies were used to obviate different symptoms, as, blisters for his difficulty of breathing; ipecacuanha and rhubarb for his *diarrhæa*; and diuretics for his dropical symptoms, as, crystals of tartar, spirit of nitre, and friction of the abdomen with olive oil and spirit of turpentine. But Fixed Air appeared to be the remedy the most efficacious in restoring his health; which he recovered almost perfectly in a week after he began to take it. The *alkaline* and *acid* juleps were administered pretty regularly; and I attribute much good effect to the following method of exhibiting wort in a *fermenting*

menting state. Less than an equal bulk of wort was drawn from the malt, namely, from six pints of malt, about five pints of wort. With a pint of this wort, a tea-spoonful of yeast was well mixed, the vessel was covered close, and placed near the fire. In less than an hour it began to ferment, and was drank in that state. This patient took about a pint every 24 hours. I am persuaded that the wort is greatly improved by this process. Yeast excites in the wort a vinous fermentation and copious generation of Fixed Air; without such addition, its spontaneous change is into an acetous state, by which very little Fixed Air is evolved."

§ 5. *Pulmonary Consumption.*

Dr. Percival has tried Fixed Air in more than thirty cases of *Phthisis Pulmonalis*. The hectic fever was in several instances abated, and the matter expectorated became less offensive and better digested :

digested: he ingenuously confesses however, that he has not been so fortunate as to cure one single patient by this remedy. (*r*) Dr. Withering informs Dr. Percival, that he has been more successful; that one phthifical patient was entirely recovered by inspiring Fixed Air; that another was rendered much better; and that a third, whose case was truly deplorable, seemed to be kept alive by it for more than two months. (*s*)

Dr. Hulme has likewise given this remedy in hectic fevers, attended with pulmonary complaints, and he thinks with success. (*t*)

With respect to my own experience of the effects of Fixed Air in pulmonary consumptions, I have never met

(*r*) *Essays Medic. and Exp.* vol. 2, p. 72.

(*s*) *Ibid.* p. 73.

(*t*) *A safe and easy remedy, &c.* p. 17.

with one instance, in which the patient recovered by the use of this remedy, when the disease originated from tubercles. But in cases of abscess in the lungs, whether from peripneumony or accidental injury, I have seen very salutary effects from Fixed Air.

C A S E XI.

Fuller Turkey, about forty years of age, was made an out-patient of the hospital, November 25th, 1773. He was a sailor, and had been cruelly treated nine or ten months before, when out at sea. He was thrown down, and received such violent blows, when in this situation, that several of the ribs on the right side were broken, and the lungs much injured. The consequence of which was, that he had great pain in the side, a very painful cough, and spit blood frequently, and in large quantities. When I first saw him, the *hæmoptoe* had ceased, but the cough
and

and pain were worse, the respiration very difficult, the breath very offensive, with a copious expectoration of purulent matter, night sweats, and the pulse from 120 to 130.

Bleeding in small quantities, emetics, anodynes, demulcents, had not the least power to check the progress of the disease; so that by December the fourth he was become extremely weak, and not able to quit his bed; the respiration still more difficult and suffocating, the breath so offensive as to taint the whole room, and the pulse still more frequent.

He was now directed to receive into the lungs, the Fixed Air of chalk detached by the acid of vitriol, and to take the salt of tartar and lemon juice in the state of effervescence three times a day. In seven days, the cough was more moderate, the respiration easier,
the

the spitting, hectic, and night-sweats diminished, and the breath not at all offensive. In four weeks more, he had gotten strength and flesh, and was free from his pulmonic affections.

C A S E XII.

About the same time with the above patient, a young gentleman was under my care, on account of an abscess in the right lobe of the lungs. There were repeated collections of matter, and repeated ruptures, with great discharges of blood as well as pus. The breath was intolerably offensive, the cough very painful and troublesome, with hectic and sweats.

This patient recovered, and received evident benefit from the effervescent draughts, and the inspiration of Fixed Air.

§ 6. SEA SCURVY.

The scurvy, properly so called, is a disease which in this climate, rarely occurs on land, especially to those who live on fresh vegetables and sound animal food. I have met, however, with some cases of the true scurvy, to which none of the usual and known causes of this disease appeared to have contributed. In the Summer of the year 1776, I was consulted for a young lady who had the following complaints; purple spots on the arms and legs, cramps and pains in the limbs, pulse small but not frequent, oppression on the breast, debility, fœtid breath, with soft and spongy gums, from which there were considerable hemorrhages. This patient drank water saturated with Fixed Air, took the effervescing draughts, and was allowed to eat ripe fruit at pleasure; she was perfectly recovered in the course of three weeks. Many seamen, afflicted with the scurvy, on coming into port have

have been under my care, and have been cured by the effervescing draughts, or by proper doses of Mr. Bewly's mephitic julep washed down with lemonade.

Dr. Macbride, who has been very laudably attentive to the means of checking the ravages of the scurvy during long voyages, recommended some years ago the use of *wort* or *infusion of malt*. "Every kind of recent vegetable, says the Doctor, that can be taken in the way of diet, will cure the scurvy; *wort*, or *infusion of malt*, is similar in it's qualities to the fresh juices of many of these, and therefore ought to produce similar effects: let this infusion be substituted for the fresh juices, and observe whether it cures the scurvy; for if it does, then a remedy for this disease need never be wanting; because malt, when well dried, will remain sound for years, may be carried to sea, and always
kept

kept in readiness, in case the scurvy should break out among the crew." (*u*)

It was difficult to get such trials of the *wort* to be made, as were necessary to confirm the truth of this ingenious theory, and answer the benevolent expectations of its author. This however appears at last to be accomplished. Dr. Macbride has favoured me with the following account of the present state of his evidence, with respect to the efficacy of the *wort*.

“ The first account that I had of the wort’s having been tried at sea, was from the surgeon of His Majesty’s ship *Jason*, in April 1772 ; and the second was received in a few months afterwards, from the Surgeon of the Nottingham East-Indiaman. Both of these, I presume, you must have seen, as I published

(*u*) Appendix to Dr. Macbride’s Methodical Introduction to the Theory and Practice of Physic, p. 639.

published the Cafes, which were ten in number, soon after they came into my hands, in a small pamphlet, under the title of *an historical account of a new method of treating the scurvy at sea*; and again, in 1772, as an appendix to a book, which I called *a methodical introduction to the theory and practice of physic*.

“ I did imagine that these Cafes (six of which are sufficiently conclusive in favour of the wort) would have gone near to establish the credit of the malt infusion as an antiscorbutic; but my expectations, it seems, were rather too sanguine, since I find they did not serve to convince the person whom of all others I could have wished to be convinced, namely, Dr. Lind; who still continues to pronounce, “ that it is not probable a remedy for the scurvy will ever be discovered from a preconceived hypothesis, or by speculative men in the closet.” And he complains, more-
over,

over, “ of the mischief done by an attachment to delusive theories.” *See the preface to the third edition of his Treatise on the Scurvy.*

“ In the same appendix, you have some little account of the success of the wort on board the *Queen East-Indiaman*; as also a short abstract of the journals, delivered in at the Admiralty Office, by the surgeons of the *Dolphin*, *Swallow*, and *Endeavour*; together with a remarkable history communicated by Dr. Fothergill, wherein the efficacy of the wort was very conspicuous.

“ Since the time of the last-mentioned publication, I have received the journal of Mr. Skiddy, surgeon of the *Intrepid* man of war, on a voyage to India, in 1772; and that of Mr. Patten, surgeon of the *Resolution*, during her late voyage to the southern hemisphere, of which we have the two-fold history, by Capt. Cooke and Mr. Forster.

“ Mr. Skiddy gives a very distinct account of about twenty scorbutic patients, though he says there was more than double that number on his sick list. It appears that the ship was but scantily provided with water, and for that reason he could not afford more than two quarts in the day of the infusion, to such of the sick as stood most in need of it, and three pints to those whose distresses were less urgent. Only two patients of the whole number could be said to recover, while the ship continued at sea, but all of them were kept alive, and in most, the progress of the disease appears to have been retarded; insomuch, that when the sick were landed at Madagascar, they every man recovered, in a very short time. Mr. Skiddy mentions his surprize, on finding that few of his patients who took the wort, were purged by it; but he accounts for this circumstance, from their being suffered to live too much on flour

flour and water boiled up together, and to eat too freely of a crude kind of pastry, which the sailors call dough-boys (or dumplings) and pandowdles, which are cakes made of only flour and water, and fried in beef fat.

“ This regimen, no doubt, would counteract the laxative quality of the wort, and consequently render it less efficacious.

“ With respect to the success of the wort on board the Resolution, the public is already pretty well informed, from the two histories of the voyages already mentioned, and from Sir John Pringle’s discourse annexed to Capt. Cooke’s account. But the surgeon’s journal, in my possession, is still more explicit and satisfactory; for whereas Captain Cooke makes a doubt whether the wort will cure the scurvy in an advanced state, at sea; the cases in Mr. Patten’s journal

K 2 demonstrate,

demonstrate, that it will; and he expresses his opinion, that the wort (if the malt be sound, and the infusion properly prepared,) will seldom fail to accomplish a cure, even though the ship should happen to be kept out at sea; and he thinks that when it has failed, the disappointment has been owing, either to the unsoundness of the malt, inattention with respect to preparing the infusion, or not administering it in sufficient quantity. There will, no doubt, however, sometimes occur such an untoward combination of severe weather, scarcity of water, bad provisions, and a crowded ship, that even the most approved antiscorbutics, if they were to be had, must fall short of their usual effects; as seems to have been the case on board the *Swallow*, in her passage across the Pacific ocean; and in the *Talbot* East-Indiaman, according to Mr. Clarke's account, in his book
entitled,

entitled, *observations on the diseases, in long voyages, to hot climates.*" (x)

The following case was communicated to Dr. Haygarth by Mr. Dawson, of Sedbergh, Yorkshire, whom the Doctor represents as distinguished for his knowledge in medicine, and other branches of natural philosophy.

C A S E XII.

" Last September I was called to a boy, about 14 years of age, who had a violent hemorrhage from his nose. When I saw him the bleeding was over, but it had been so profuse, that his strength was very much reduced. He was covered all over with purple or livid spots, many of them the breadth

(x) Extract of a letter from Dr. Macbride to the author.

While it was in the press, I heard, with deep concern, that he was no more. The loss of a Physician of learning, integrity, and humanity, with a happy genius for inquiry and observation, in the prime of *medical life* and devoted to the duties of his profession, is a misfortune to his friends, to the faculty, and to mankind. Such was my truly amiable and ingenious friend Dr. Macbride!

of

of a silver threepence ; his fingers and toes did not escape. Upon his breast, one half at least, was covered with them. His breath was extremely offensive, his breathing laborious, and his gums were so spongy, that the slightest touch made them bleed. His pulse between 130 and 140. These symptoms presented themselves immediately upon inspecting him. Upon inquiry of his nurse, she informed me, that his stools were very black and foetid ; and she shewed me his water, which deposited an inky sediment.

“ I ordered him to be kept in a half-sitting posture in bed, slightly covered, the windows and door open. The acid elixir of vitriol and bark were attempted to be given, but he could not be prevailed upon to take them. I therefore gave him 12 or 15 grains of salt of tartar, dissolved in water, and saturated with the mephitic acid ; and immediately
after,

after, such a quantity of lemon juice, diluted with water, and made pleasant with sugar, as would saturate the salt. This dose was repeated every two, three, or four hours.

“ I likewise attempted to make use of Fixed Air, in the manner recommended by Dr. Rotherham, but his breathing was so difficult he could not bear it. However, a mixture of chalk and water, into which oil of vitriol was poured, was frequently carried into the room where he lay.

“ No other means but those above-mentioned, together with an antiseptic diet, were made use of; and they had the desired effect, for he grew every day a little better, till his health was perfectly recovered in seven or eight weeks time.”

In a subsequent letter he writes, “ I
have

have had a putrid case lately, similar to that I sent you, which I treated in the same manner, and with the same success. It was a child between four and five years old, who would take neither bark nor the mineral acids, but there was no difficulty in administering *any* quantity of Fixed Air."

Dr. Hulme recommends the following method of administering Fixed Air, for the cure of the scurvy at sea :

" Take of pure salt of tartar one ounce, (troy weight,) dissolve it in sixteen ounces of common water ; and call it the *alkaline mixture*. Also, take of weak spirit of vitriol two ounces, (in measure,) of common water fourteen ounces, so as to make in the whole sixteen ounces, to be called the *acid mixture*. Let the patient take half an ounce (in measure) of the *alkaline mixture*, in three ounces of common water, four times

times a day ; and immediately afterwards, let him take half an ounce of the *acid mixture*, in the same quantity of water ; and continue these medicines, till the scorbutic symptoms disappear, and the patient's strength be restored ; which may be expected to happen in about the space of three weeks. If occasion should require, the dose may be increased to double the quantity. In this composition the acid, by design, is made predominant." (y)

Dr. Hulme relates the history of one scorbutic patient, whose complaints were removed by the use of this medicine.

After having thus treated of the effects of Fixed Air in diseases of the putrid class, I shall in the two subsequent sections, as a further illustration of this subject, make some observations and experiments on putrefaction.

(y) A safe and easy remedy, &c. p. 11.

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SECTION

SECTION IV.

Of PUTREFACTION, the PUTRID EFFLUVIUM, and the means of correcting the PUTRID EFFLUVIUM.

Putrefaction is the great process appointed by the CREATOR, for the resolution of animal and vegetable substances into the elements from which they were first formed. By this process, the oak and the bramble, the cedar and the hyssop, fruits whether delicious and nutritive, or acrid and poisonous, the most beautiful of the human species, and the most deformed of any of the other tribes of animals, are all reduced to one common lot; nor are the elements to which they return to be distinguished from each other.

This resolution of bodies, when philosophically considered, is equally wonderful with their formation; and is alike governed by regular and invariable laws. Every seed produces its own
plant,

plant, and every animal brings forth one of its own species ; they live, they are nourished, and each retains it's individual nature ; they die, they decay, return to their elementary state, and are again employed as the constituent parts of other vegetables and other animals. Such, with respect to the material part of the creation, is the amazing circle of Life and Death ! A circle in which Nature keeps her steady rounds, and moves agreeable to laws fixed by the ALMIGHTY.

Sir *Isaac Newton* very aptly illustrates this stability in the Laws of Nature.

“ While the primitive particles of matter continue entire, they may compose bodies of one and the same nature and texture in all ages : but should they wear away or break in pieces, the nature of things depending on them would be changed. Water and earth composed of old worn

“ particles and fragments of particles,
 “ would not be of the same nature and
 “ texture now, with water and earth
 “ composed of entire particles in the
 “ beginning. And therefore, that Na-
 “ ture may be lasting, the changes of
 “ corporeal things are to be placed
 “ only in the various separations and
 “ new affociations and motions of these
 “ permanent particles ; compound bo-
 “ dies being apt to break, not in the
 “ midst of solid particles, but where
 “ those particles are laid together, and
 “ only touch in a few points.” (z)

During the resolution of bodies by
 putrefaction, a considerable proportion
 of their parts is volatilised ; and the *ef-
 fluvia* thus thrown off, are more or less
 pernicious, according to the circum-
 stances which accompany the putrefac-
 tive process.

(z) See Sir Isaac Newton's *Queries*, at the end of
 his *Optics*, 8vo. 3d edition, page 376.

I. *Animal*

1. *Animal effluvia*, from the living body even in health, are not to be considered as innocent. When accumulated, and repeatedly respired, they are well known to be prejudicial to the animal œconomy, diminish the energy of the brain and nervous system, and weaken the action of the heart and arteries. Hence the pale complexions, numerous diseases, and anticipated deaths, of those who inhabit large towns and populous cities.

2. *Church-yards* are another source of noxious *effluvia*. These are generally formed in the midst of crowded towns; and the more crowded the towns, the more constantly are they broken up. One generation is removed to make room for another; and I have seen bodies yet *green in death*, forced from the grave, and exposed to the open day! Health, humanity, decency, cry aloud against such barbarities.

3. *In*

3. In *Poor-houses, Charity-schools*, and other places in which numbers are crowded under the same roof, and sleep in the same apartment, the pernicious effects of putrid *effluvia* are likewise easily traced. There is something peculiarly disagreeable and debilitating, in the smell of such apartments. Hence probably we are led to the principal cause why scrophulous complaints are so prevalent in charity-schools and poor-houses; for as the children are constantly surrounded with an acrid atmosphere of their own effluvia, their constitutions are vitiated, and an early and habitual debility produced.

It is an observation made by Dr. Priestley, "that young mice will always live much longer than old ones, or than those which are full grown, when they are confined in the same quantity of air. I have sometimes known a young mouse to live six hours in the same circumstances

cumstances in which an old mouse has not lived one." (a) With respect to the human species, in situations somewhat analogous to the above, the effects appear to be the reverse; for in crowded and ill aired poor-houses, old people are comparatively little injured, while the children become weak and sickly; and when putrid fevers break out in such places, the young subjects are generally first attacked.

4. *Hospitals* injudiciously built, and which, from their construction, cannot have a full and free ventilation, are likewise infested with putrid *effluvia*. Hence the source of that fever which is peculiar to hospitals; a fever which may be said to be indigenous, and which will always prevail in proportion to the vitiated state of the air.

On this subject we have some very

(a) Experiments on Air, vol. 1, p. 72.

useful

useful observations by my ingenious friend Mr. Aikin, in his *Thoughts on hospitals*.

5. In *Jails and Prisons*, where the putrid *effluvia* is still more closely confined, the effects are too often fatally marked by the *Jail Fever*. This fever has in some instances been propagated beyond the jails, and produced great havock ; of which the *black assize* at Oxford, in the year 1577, was a dreadful example ; when the judges, gentry, and almost all who were present, to the number of three hundred, were killed by a poisonous vapour. This vapour was thought by some to have broken forth from the earth ; but more justly supposed, by Lord Bacon, to have been brought by the prisoners out of the jail into the court ; for it was observed that the prisoners were the only persons not injured by this vapour. (*b*)

(*b*) Camden. Annal. Regin. Eliz. And Ld. Bacon's Natural History, cent. 10, num. 194.

6. The

6. The *Plague*, which is a fever of a still more malignant nature, arises from the *putrid effluvium* exalted by certain circumstances and in certain climates, into a yet more dangerous *miasma*; and which, as it spreads, forms the most destructive *contagion*. In some instances, this contagion arrests as it were the vital powers, and proves almost instantly fatal. In the year 1726, an English ship took in goods at Grand Cairo, in the time of the plague's raging there, and carried them to Alexandria. Upon opening one of the bales in a field, two Turks, who were employed in the work, were immediately killed. (c) It was likewise observed, that the porters who opened the infected bales of goods in the lazarettos of Marseilles, died upon the first appearance of infection; they were seized with rigors, tremblings, sickness, vomitings, and giddiness and heaviness of the head; there was an universal languor

(c) Mead on the Plague, p. 198.

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and

and inquietude, the pulse low and unequal, and death ensued sometimes in a few hours. (*d*)

The *Putrid Effluvium* is thus noxious in different degrees, according to the circumstances which accompany either its production or confinement. Nature is wisely, however, and uniformly employed, in so changing this product of putrefaction, as to render it generally either innocent or useful. Was not this the case, the quantity accumulated would be soon so great, as to destroy the whole race of mankind.

It is not easy to trace out the steps which nature takes, to accomplish this her salutary purpose, but it is probable that the following will be found to have considerable efficacy.

1. *Dispersion*. The *Effluvia* which arise
(*d*) Mead on the Plague, p. 186.

during

during the putrefactive process, become less and less injurious in proportion as they are dispersed and diluted. Hence the good effects of a free ventilation in hospitals, poor-houses, jails, and wherever animal exhalations are collected; and of brisk gales and high winds, in changing the atmospheres of cities and large towns.

2. *Vegetation.* Air which has been rendered unwholesome by respiration or putrefaction, is meliorated and again made fit for the support of animal life by the growth of vegetables. This is a discovery, as curious as it is important; and for which we are indebted to the experiments and sagacity of Dr. Priestley. “In no other circumstances have I ever seen vegetation so vigorous as in air freshly and strongly tainted with putrefaction, and which is immediately fatal to animal life. Though these plants have been crowded in jars

filled with this air, every leaf has been full of life ; fresh shoots have branched out in various directions, and have grown much faster than other similar plants, growing in the same exposure in common air.

“ This observation led me to conclude, that plants, instead of affecting the air in the same manner with animal respiration, reverse the effects of breathing, and tend to keep the atmosphere sweet and wholesome, when it is become noxious, in consequence of animals either living and breathing, or dying and putrefying in it.” (e) This conclusion appears to have been clearly and fully established by Dr. Priestley’s subsequent experiments and observations.

3. *The completion of the putrefactive process, and the consequent return of the putrefying subject to its elementary*

(e) Dr. Priestley’s Experiments on Air, vol. 1, p. 86.
state,

state, form another means employed by nature for the restoration of noxious air.

By the digestive process, the aliment is so changed as to become a part of the animal which it nourishes; and by the putrefactive process, this animal passes into a state of dissolution, loses its texture and organization, and rises into the air in the form of vapour. Part of this vapour is absorbed by growing vegetables, nourishes and becomes a part of their substance; and thus the air is so far freed from the noxious impregnation. What remains is still further dispersed, and passing, by the wise provision of nature, thro' various changes and combinations, returns to the state of elements; and these elements become again the constituent parts of other vegetables and other animals.

4. *Fire and smoke* have likewise been found powerful correctors of putrid *effluvia*, and of the infectious *miasmata* which excite putrid fevers. The accurate and judicious Dr. Lind says, “ I seldom or ever knew a proper application of fire and smoke to be unsuccessful in producing the happy consequence of effectually purifying all tainted places, materials and substances.” (f) In another place he says, “ a proper application of fire and smoke, is the true means appropriated for the destruction and utter extinction of the most malignant sources of disease. They are besides the greatest purifiers of all bad and tainted air.” (g) These however are to be considered rather as artificial than natural means of correcting putrid *effluvia*; and to do it effectually, the heat and smoke of the burning mate-

(f) Two papers on fevers and infection, p. 44.

(g) Ibid. p. 49.

rials, must be long and closely shut up wherever the contagion is supposed to lurk.

5. *Fixed Air* has also been supposed to have the power of sweetening the putrid effluvium, and of thus meliorating air which has been tainted by putrefaction. This point will be examined in the next section, which treats of the relation of Fixed Air to putrefaction and the putrid effluvium.

SECTION V.

Of the Effects of FIXED AIR, on the
PUTREFACTIVE PROCESS and on the
PUTRID EFFLUVIUM.

I. A German writer of the last century, relates a singular fact, which proves the antiseptic power of Fixed Air. The waters of *Schwalbach* in the Landgravate of Hesse, are so strongly impregnated with Fixed Air, that it is thrown off in large quantities into some
rocky

rocky caverns, through which these waters pass before they issue to the day. Merian, in his *Topographia*, takes notice, that every kind of animal substance is preserved in these cells from putrefaction. “*In æstuosissima etiam æstate carnes quascunque absque omni putredine et fœtore conservari.*” (b)

Merian thus points out the effects of this volatile principle, without being acquainted with the true nature of the principle itself. The Hon. Mr. Boyle was the first who ascertained the *antiseptic* power of some kinds of factitious air; Sir John Pringle discovered, that putrid substances were *sweetened* by being immersed either in fermenting or effervescent mixtures; and Dr. Macbride has clearly proved, that it is the *Fixed Air* produced in these mixtures, which recovers putrid substances to a state of sweetness.

• (b) Merian *Topographia Hassiæ*. p. 123, et 127.

Some

Some ingenious conjectures have been made, with respect to the manner in which Fixed Air operates, either in preventing putrefaction, or in sweetening those substances which are already become putrid.

“ How are we to explain, says Dr. Percival, the sweetening powers of Fixed Air? An eminent philosopher seems to hint that Fixed Air may act as a *menstruum* for the putrid *effluvium*, and thus imbibe or discharge it from the septic body.” (i)

Mr. Henry likewise says, “ There appears to be some degree of probability, that Fixed Air, in restoring sweetness to putrid bodies, produces this effect, by acting as a *menstruum* to the putrid *effluvia*.” (k) This supposition was suggested to Mr. Henry by the following

(i) *Essays Medic: and Exper.* vol. 2, p. 83.

(k) *Experiments and Observations*, p. 142.

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experiment: "A piece of putrid beef, after having been suspended in an atmosphere of Fixed Air for thirteen hours, was very considerably, though not entirely sweetened. *But the air in the bottle seemed to have acquired all the putrid smell of which the flesh had been deprived.*" (1)

Now if the sweetening power of Fixed Air, arises from its acting as a menstruum to the putrid effluvium, whence is it, that in putrid fevers, in which the whole habit is affected, the putrid process is checked by even small quantities of Fixed Air, taken either by the mouth or administered in clysters? We cannot suppose, that the putrid effluvium, in consequence of its strong affinity with Fixed Air, is abstracted from the whole system; or if it was, that it would be rendered innoxious; for it appears from Mr. Henry's Experiment,

(1) Henry's Exp. and Observ. p. 122.

that

that it still retains its offensive smell, tho' united with Fixed Air. Besides, *mere abstraction* of the putrid effluvium affords only a partial solution of the question ; and does not explain, whence it is that the *further production* of the putrid effluvium is prevented : an effect, which does not proceed from abstraction, but from the power which Fixed Air actually possesses, *of putting a stop to the putrefactive process*. For if the cause be thus removed, the effect will cease of course. Hitherto, therefore, no further advance has been made on this subject, than to ascertain, *that Fixed Air destroys the putrefactive fermentation*.

As to the explanation of that power in Fixed Air, by which it *retards* or even *prevents* putrefaction, nothing satisfactory appears yet to have been suggested.

Dr. Alexander has endeavoured to

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establish a very extraordinary doctrine, which is, that bodies are preserved from putrefaction by being surrounded with putrid matter. Conformable to this idea, Doctor Percival conjectures, (*m*) “ that Fixed Air may restrain and even “ prevent putrefaction, without possessing any inherent antiseptic quality. “ For by surrounding the putrescent “ substance with that kind of air, which “ it yields by putrefaction, and which “ requires some vehicle to discharge or “ carry it off, the separation of it is “ prevented, and the body thus retained in its original state.” Dr. Priestley likewise says, “ I think it probable enough, that putrid matter, as “ Dr. Alexander has endeavoured to “ prove, will preserve other substances “ from putrefaction ; because being already saturated with the putrid efflu- “ vium, it cannot readily take more.” (*n*)

(*m*) Essays Med. and Exp. vol. 2, p. 81.

(*n*) Exp. and Observ. vol. 1, p. 197.

To determine this point, I made the following experiments :

EXPERIMENT I.

A piece of fresh mutton was suspended by a thread in a phial which held twenty ounces ; at the bottom of this phial lay some putrid flesh, and the phial was corked. A piece of the same mutton was in like manner suspended in another phial, which contained nothing but common air, and this phial was likewise corked. At the end of twelve hours, I examined the first piece of mutton, after washing it well for five minutes in fresh water, and found it very offensive. The piece in the other phial was perfectly sweet.

EXPERIMENT II.

Two pieces of fresh veal were suspended in the same manner for fifty-four hours ; that in the putrid air was
tender

tender and very offensive, while the other piece remained still sweet.

It is surprising to observe the extravagant and even dangerous conclusions, to which medical writers have sometimes been led by false theories or mistaken facts. Of this we have a striking instance in Dr. Alexander's *Experimental Inquiry*, where he quotes two passages, one from Benet and the other from Pictorius. (o) “ Among the more rude
 “ and barbarous nations, says Dr. Alexander, we frequently meet with customs which at first view seem totally
 “ repugnant and irreconcilable to reason ; and yet upon considering them
 “ more attentively, we generally find
 “ that they have some foundation in nature, and have taken their rise from
 “ experience and observation. Thus
 “ we are told by Alexander Benedictus,

(o) Exp. Inquiry concerning the causes of putrid diseases, p. 75, 76.

“ that

“ that a physician among the Tartars,
“ in the time of a severe plague, or-
“ dered all the dogs to be killed and
“ thrown into the most public streets
“ and roads, that the atmosphere might
“ be filled with a putrid smell; by which
“ means, he says, the people were re-
“ stored to health, and that they con-
“ tinue still the same practice in like
“ cases. (*p*) And similar to this, we
“ are also informed by Gregorius Pic-
“ torius, that he had heard some per-
“ son affirm, that in the time of an
“ epidemic infection, nothing was bet-
“ ter or more salutary, than for every
“ one to smell, three times a day, ei-
“ ther a necessary-house or a sheep-
“ house. (*q*) Is it possible that these
“ customs, seemingly so contradictory
“ to reason, could arise from chance;
“ were they not rather deduced from
“ observations similar to those above re-

(*p*) Alex. Benedict. de Peste, cap. 6.

(*q*) Greg. Pictor. Dialog. 2, de bona valetudine.

“lated concerning excrement and marsh
“water?”

Such facts, and such conclusions, require no comment! They only show to what strange extremes, ingenuity may sometimes be subtilized.

The question whether putrid marshes are or are not unwholesome, is a question of considerable moment; Doctor Priestley therefore, by a clear and conclusive experiment, has proved, that the vapour which arises from putrid water is exceedingly noxious, and thus guards against the mischief which might proceed from a careless belief of the doctrine advanced by Dr. Alexander. “Happening, says Dr. Priestley, to use at Calne a much larger trough of water, for the purpose of my experiments, than I had done at Leeds, and not having fresh water so near at hand as I had there, I neglected to change it, till it
turned

turned black and became offensive, but by no means to such a degree, as to determine me from making use of it. In this state of the water, I observed bubbles of air to rise from it, and especially in one place, to which some shelves, that I had in it, directed them; and having set an inverted glass vessel to catch them, in a few days I collected a considerable quantity of this air, which issued spontaneously from the putrid water; and putting nitrous air to it, I found that no change of colour or diminution ensued, so that it must have been in the highest degree, noxious." (r)

The celebrated Dr. Franklin, has likewise pointed out the pernicious effects of the *Marsh effluvium*. Speaking of the flame which may be lighted up on the surface of some American waters: "I have tried, says this excellent philosopher, the experiment twice here in Eng-

(r) Experiments on Air, vol. 1, p. 198.

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land,

land, but without success. The first was in a flow running water, with a muddy bottom. The second, in a stagnant water at the bottom of a deep ditch. Being some time employed in stirring this water, I ascribed an intermitting fever, which seized me a few days after, to my breathing too much of that foul air which I stirred up from the bottom, and which I could not avoid while I stooped in endeavouring to kindle it." (f)

II. The effects of Fixed Air on the putrefactive fermentation having been thus considered, the next inquiry is into the effects of this fluid on the *product* of putrefaction or the proper putrid *effluvium*.

It appears to be the general opinion, that Fixed Air meliorates and sweetens air which has been rendered noxious by

(f) Dr. Priestley's Experiments, vol. 1, p. 323:

respiration

respiration or putrefaction; and Dr. Priestley's experiments seem to favour this opinion. " Having found, says the Doctor, by several experiments above mentioned, that the proper putrid effluvium, is something quite distinct from Fixed Air, and finding, by the experiments of Dr. Macbride, that Fixed Air corrects putrefaction; it occurred to me, that Fixed Air, and air tainted with putrefaction, tho' equally noxious when separate, might make a wholesome mixture, the one correcting the other; and I was confirmed in this opinion by, I believe, not less than fifty or sixty instances, in which air, that had been made in the highest degree noxious, by respiration or putrefaction, was so far sweetened, by a mixture of about four times as much Fixed Air, that afterwards mice lived in it exceedingly well, and in some cases almost as long as in common air.

“ The reason why I do not absolutely conclude that the restoration of air in these cases, was the effect of Fixed Air, is, that when I made a trial of the mixture, I sometimes agitated the two kinds of air pretty strongly together, in a trough of water, or at least passed it several times through water, from one jar to another, that the superfluous Fixed Air might be absorbed, not suspecting at that time that the agitation could have any other effect. But having since found, that very violent, and especially long continued agitation in water, without any mixture of Fixed Air, never failed to render any kind of noxious air in some measure fit for respiration, I began to entertain some doubt of the efficacy of Fixed Air in this case. In some cases also, the mixtures of Fixed Air had by no means so much effect on the putrid air, as from the generality of my observations, I should have expected.

“ Upon

“ Upon the whole, I am inclined to think that this process could hardly have succeeded so well as it did with me, and in so great a number of trials, unless Fixed Air have some tendency to correct air tainted with respiration or putrefaction; and it is perfectly agreeable to the analogy of Dr. Macbride’s discoveries, and may naturally be expected from them, that it should have such an effect.” (t)

As Dr. Priestley has suggested a doubt with respect to the conclusiveness of his own experiments, from the circumstance of the two kinds of air being agitated together in water; I determined to repeat the experiments in a manner, which could admit of no such doubt. The experiments were made by means of an *Eudiometer*, with which I was obligingly furnished by Dr. Falconer. It is a graduated glass tube, about sixteen

(t) Priestley’s Experiments on Air, vol. 1, p. 98.

inches in height, and three fourths of an inch in diameter, and which at the lower end, beneath the graduations, opens into a trumpet-mouth for the convenience of standing. The graduated part of the tube is formed into six divisions, each division containing one measure; and each measure is again subdivided into sixteen parts, so that the diminution on the admixture of different kinds of air may be accurately marked.

It is further to be observed, that both the nitrous air and the Fixed Air were fresh made. The nitrous air, from clean copper filings and strong smoking spirit of nitre, diluted with about six times its quantity of water; and that the nitrous acid might be quite pure and free from the marine, it was procured from the crystals of nitre by means of the vitriolic acid.

To

To determine what diminution a given quantity of Fixed Air suffers, in passing through a column of water of a given height, I made

EXPERIMENT I.

Two measures of Fixed Air in passing through the water in the *Eudiometer*, lost rather more than half a measure: and from four measures tried in the same manner, there was a diminution of one measure. So that a fourth part of a given quantity of Fixed Air, is absorbed as it rises through a column of water of about fourteen inches in height.

To ascertain whether there is any diminution on the mixture of Nitrous Air with Fixed Air, I made

EXPERIMENT II.

One measure of Nitrous Air was added to four measures of Fixed Air, and there was a diminution of one sixteenth of

of a measure. This experiment was several times repeated, and the diminution was always nearly the same.

These particulars being premised, I proceeded to the experiments on the putrid *effluvium* or air tainted with the product of putrefaction.

EXPERIMENT III.

To one measure of highly putrid air, was added one measure of Nitrous Air, and without any diminution; a proof that the putrid air was perfectly noxious.

EXPERIMENT IV.

To one measure of the same putrid air, were added four measures of Fixed Air; and to determine whether the putrid air was meliorated by this addition, one measure of Nitrous Air was added as a test. There was a diminution only of one sixteenth of a measure. This
experiment

experiment was frequently repeated; and it was always found, that there was no further diminution, than what would have arisen from adding one measure of nitrous air to four measures of Fixed Air. Consequently there had been no melioration of the Putrid Air, by its admixture with the Fixed Air.

As I wished to have the result of this experiment clearly ascertained, I requested Mr. Henry, of Manchester, to take the trouble of repeating it. This request was readily complied with, and Mr. Henry, without being acquainted with the particulars of my experiment, transmitted to me by letter, the following account of one made by himself.

EXPERIMENT V.

“ One measure of Nitrous Air, added to two of highly Putrid Air, produced no diminution. I then mixed one measure of the same Putrid Air with

P two

two measures of Fixed Air, and put it to the test of one measure of Nitrous Air. As soon as they were mixed, I perceived the water to rise in the *Eudiometer*, and on reckoning the diminution which had taken place, I found it to be something more than 1-20th.

“ The air was rendered putrid by placing a piece of mutton in a bottle, which was suffered to putrefy before the bottle was corked. It was then stopped closely from the external air, and never opened till the experiment was made, when it was uncorked under water.”

It appears however from experiments II. and IV. that the small diminution here marked by Mr. Henry, proceeded from the mixture of the Nitrous Air with the Fixed Air, and not from the melioration of the Putrid Air.

The conclusion to be drawn from the
preceding

preceding inquiry, is this ; that there is a distinction to be made between putrefaction, and the product of putrefaction ; and that Fixed Air checks or puts a stop to the putrefactive fermentation, but does not meliorate or sweeten the putrid effluvium the product of putrefaction. Hence we see, why in Mr. Henry's experiment the tainted beef was sweetened, while the air in the bottle remained very offensive. Hence likewise we see, why *lime kilns* in the neighbourhood of populous cities, or large vessels of fermenting liquors placed in rooms filled with noxious air, can have no effect in meliorating this, except the Fixed Air which is thrown out, come in contact with the putrefying body ; it may then indeed check the putrid fermentation, and thus be of use by cutting off the source whence the putrid effluvium is derived.

SECTION VI.

Of the Use of Fixed Air in Cachexies,
and Phagedenic Ulcers.

In genuine and confirmed cancers, I have never found any sensible progress towards a cure, or any considerable benefit, further than a mitigation of the pain, from the use of Fixed Air: but in old, spreading, ill-conditioned ulcers, I have employed this remedy with obvious advantage. It has in many instances relieved the pain, brought on a more favourable digestion, and much improved the appearance of the ulcers; and in some, it has effected a complete cure.

CASE I.

James Rider, about thirty-six years of age, was made an out-patient of the hospital, April 8, 1773. He had been afflicted for more than two years, with a painful ulcer, which was spreading
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ing over the roof of the mouth. On examining the part, I found the ulcer of an irregular and jagged surface, with a disagreeable smell; and it had extended itself over the *velum pendulum palati*, and the greatest part of the arch of the mouth.

He took the solution of the *corrosive sublimate* in the manner now generally directed, and two scruples of powdered *sarsaparilla* three times a day. The ulcerated part was likewise well washed, with the common gargle and tincture of myrrh. These remedies were continued for fourteen days, without producing any appearance of amendment. He was directed therefore to take the effervescent draught three times a day.

The pain abated, the diseased part put on a more kindly aspect, and was perfectly healed by the eighth of May. The Fixed Air was not in any other manner

manner immediately applied to the ulcer, than as it came in contact with it during his swallowing the effervescing mixture. I saw him several weeks after this, and on examining the mouth found it perfectly sound.

In some instances, it is necessary to persevere for a long time in the steady use of this medicine, to complete the cure, as appears from the subsequent history.

C A S E II.

Elizabeth Cox, forty years of age, became an out-patient of the hospital September the 2d, 1773. Six months before this, she began to be troubled with what she called a very painful sore throat. On examination, it appeared that the *velum pendulum*, and inside of the nostrils, were affected with a spreading ulcer. There was a considerable discharge of matter from the
nostrils,

nostrils, with very severe pains in the back and internal part of the nose. The ulcer had eaten thro' the *velum pendulum*, forming a circular opening about the size of a silver penny, and had spread so far along the back of the fauces and into the nose, as to be visible on looking into the nostrils. The discharge was offensive, sometimes mixed with little clots of blood, and at other times small pieces of bone came away with the matter; the sense of smelling was entirely lost.

I directed the usual dose of the *sublimated solution*, and a quart of malt infusion to be drank daily; and the parts were well washed with barley water and tincture of myrrh. She continued this course for about twelve days, but without the least check to the progress of the ulcer; on the contrary, the whole of the *velum pendulum* was now almost destroyed, so as to form an opening of
a very

a very terrible aspect into the upper and back part of the fauces ; nor was the violence of the pains at all diminished.

She was at this time made an in-patient ; and took a scruple of salt of tartar, with a spoonful of lemon juice every six hours, and had the diseased parts well fumigated with the Fixed Air of chalk detached by the acid of vitriol. After pursuing this plan for about five weeks, the pains were very inconsiderable, and the ulcerated *velum pendulum* quite healed ; the discharge from the nostrils was much diminished, and consisted of well-formed *pus*, and here likewise the ulcerated parts were in a very favourable and healing state. But at this time she complained much of a pain in her throat, very different she said from what she had hitherto felt ; and on inspection, there was discovered a large venereal ulcer on one of the tonsils. Whether this was an
infection

infection of long standing, or had been lately contracted, in consequence of her having again been made an out-patient, I could not discover. By taking however the *sublimate solution* for three weeks, then applying the mercurial ointment for about three weeks longer, so as slightly to affect the mouth, and drinking a decoction of sarsaparilla, the venereal complaint was entirely removed.

During the mercurial course, the former complaints became worse, the pain increased, and the discharge was again thin and offensive. The effervescent draughts therefore, and the fumigation with Fixed Air, were directed as before; and by steadily persevering in the use of these means for ten weeks, she was perfectly cured.

I have seen the same good effects, from this method of cure, in other cases

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of

of phagedenic ulcers; but was disappointed in my expectations with respect to the following patient.

C A S E III.

Jane Dean was an out-patient of the hospital, for complaints much resembling those of Elizabeth Cox. After several powerful remedies had been tried without relief, a consultation was desired. On this occasion, I mentioned the good effects I had experienced in some similar cases from the use of Fixed Air; and it was agreed, that she should take the effervescing draughts, and have the parts well fumigated with Fixed Air, as in the preceding case.

After some time, the appearances were very flattering, the pains entirely ceased, and the ulcerated parts were almost perfectly healed. On the return however of cold weather, this patient relapsed; and neither the external or
internal

internal use of Fixed Air, had then the same happy effects. Nor had I an opportunity of trying whether her steadily pursuing the same plan as an *in-patient*, would have been more successful; for she came from a distance in the country, and desisted from attending the hospital.

As the case of the following patient was attended with some singular appearances, tho' not with ulceration, I shall transcribe it.

C A S E IV.

Mrs. C, 30 years of age, in the summer of 1774, was afflicted with severe rheumatic pains of the head, neck, shoulders, and arms; which, notwithstanding the use of several powerful remedies, continued to be very troublesome for two or three weeks. She then began to complain of foreness in the throat, with a painful and difficult de-

Q 2

glutition.

glutition. It appeared, on inspection, that the tonsils and back part of the fauces were covered with something which much resembled *Pus*, and which adhered so firmly, that it could not be wiped away. From the commencement of this sore throat, the rheumatic pains were much relieved.

A blister was put between the shoulders, and several topical applications were used to the fauces, but without effect. Nothing gave so much ease, or disposed the adhering matter to separate so freely, as Fixed Air. She took the effervescent draughts, and the throat was fumigated in the usual manner.

When the parts were by these means cleared, they were red, but there were no marks of ulceration. The matter therefore with which the tonsils and fauces were covered, appears to have been the same with what Dr. Hunter, in

in his excellent paper on the *emphysema* and cellular membrane, calls an *inflammatory exudation*. (u)

This singular affection of the throat, seems to have been a rheumatic *metastasis*; for the sore throat twice alternated with the rheumatic pains of the head, shoulders and neck.

C A S E V.

In November 1776, I met with a case similar to the preceding, with this difference, that the affection of the fauces did not alternate with any rheumatic pains. Miss C. during the course of a continued fever, began to complain of foreness and uneasiness in the throat. When examined, the *uvula*, *velum pendulum*, tonsils and back parts of the fauces, were found spotted over with a substance which had the appearance of cream or whitish *Pus*. This

(u) Medic. Observations and Inquiries, vol. 2, p. 61:
substance

substance adhered firmly, was raised above the skin, and in the interstices the *cutis* was red and inflamed. Different gargles, and other applications were tried without effect; but the effervescing draughts, and the fumigation with Fixed Air, soon eased the pain, cleared the *fauces*, and removed the complaint.

From considering Fixed Air both as a tonic and as a corrector of acrimony, I was induced to give it to several SCROPHULOUS patients: in some, it has afforded sensible relief; but in none, so far as my present experience goes, has it effected a cure. In other cachexies, it has sometimes been more successfully administered.

C A S E VI.

Mrs. C. an unmarried lady, about fifty years of age, had been a valetudinarian for some time; was in a bad habit

habit of body, and had been afflicted with the jaundice for five weeks.

I first saw her in September 1772. She then complained of constant sickness, loathed food, reached frequently and sometimes vomited. The stools were white, there was a deep yellow over the whole body, and great tenderness on pressing upon the region of the liver. The urine was passed in small quantities, and tinged every thing it touched with the colour of saffron. The pulse from 85 to 105. She grew worse towards the evening, was hot and restless during the night, and so weak as to be able to sit up only for a few hours. She was much troubled with wind, and an uneasy tension about the stomach. Rhubarb with soap, and the common saline mixture, had been given for more than two months, but without affording relief, for she daily became worse.

One scruple of salt of tartar was directed to be taken with lemon juice in the state of effervescence, and repeated three times in the day. Her stomach became more settled, the sickness by degrees left her, the vomitings entirely ceased, the fever was diminished, and the nights more easy and composed, her appetite returned, and she regained her strength. The medicine was continued for seven weeks, and she was then perfectly recovered. From the time of her beginning with the effervescent draughts the flatulent complaints were much less troublesome.

This patient had a relapse about two years after, and was cured by the use of the same remedy.

C A S E VII.

Mary Tear was admitted an out-patient of the hospital, December 24, 1772. She had a singular kind of eruption

tion on the hands, arms and legs. The hands and arms were hot, and the heat was accompanied with prickling and itching ; they were swelled likewise, moist, pimpled, and chapped. The legs were covered with small blisters, which on bursting discharged some serum, and then formed into scales. She had been afflicted with these complaints five or six months, and had taken several medicines without relief. The only medicine now directed for her, was the effervescing draught, to be taken three times a day.

January 2, 1773. The medicine acts as a diuretic, and keeps the body rather more open than usual. The painful symptoms are relieved, and the diseased parts put on more of their natural appearance.

Jan. 16. The arms are now well, and the legs nearly so. She was ordered to

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go on with the medicine, and in about ten days more was perfectly free from the complaint.

I have seen a number of similar instances, in which Fixed Air thus administered, has been equally successful: and that the efficacy of the medicine depends upon the Fixed Air, and not upon the neutral salt, appears particularly from the 6th of these cases, and from others likewise, in which I had previously given the neutral salts for a sufficient length of time, without any sensible diminution of the disease.

SECTION VII.

Of the Use of Fixed Air in some diseases of the Stomach.

Those mineral waters which contain Fixed Air, have been drank with advantage in a debilitated and too irritable state of the stomach, in loss of appetite, and in habitual nausea and vomiting.

vomiting. As the good effects in these cases, have with propriety been attributed to their Fixed Air, I wished to try the same remedy in diseases of this class, as detached in the effervescing draughts.

C A S E I.

Mr. D. a young gentleman about 16 years of age, had for three years, almost entirely lost his appetite; and had frequently a strong aversion to every kind of aliment, especially to animal food. Nothing would stay upon his stomach, except a little tea or sago, and these were often rejected. Whenever he forced down any other kind of aliment, sickness ensued, and the aliment was quickly returned.

He had tried emetics, the peruvian bark, change of air, sea bathing, bitters, chalybeates, and other strengthening remedies, to no purpose.

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In October 1772, I directed the usual effervescent draught to be taken three times a day. This medicine gradually produced an agreeable change. The sickness and vomiting abated, and the appetite, though still limited, was much altered for the better. By longer persevering in the use of the medicine, he acquired strength, and enjoys a good state of health.

C A S E II.

A Gentleman about sixty years of age, had for several months a cough, frequent pulse, slight chills, and sometimes considerable night sweats. He was much reduced by these complaints, *had lost his appetite, and had an aversion to every kind of animal food.*

An emetic, the common saline mixture, the bark, and columbo root, had been given, but with little effect. He
was

was still very weak, the pulse more than 100, and he could not bear either the smell or taste of animal food. The effervescing draught was now given as in the preceding case, and indeed with surprising and almost instant relief; for in a very short time, he could eat animal food with some degree of relish; and in a few days more, his appetite was restored to its natural state. He continued the use of the medicine for three weeks; during which time he regained his strength, the pulse returned to 70, and he found himself he said quite recovered.

C A S E III.

Charles Wright was made an out-patient of the hospital in November 1773. He was 25 years of age, and had been afflicted for two months with pain in the stomach, sickness and vomiting. Whenever he eat any food, it loaded and oppressed his stomach, and
after

after two or three hours a considerable quantity of it was rejected. He took the effervescing draught three times a day, and the complaints were entirely removed in twenty days.

C A S E IV

Miss A. a young Lady of 27 years of age, was bled in the arm on account of a very troublesome cough and hoarseness. During the following night, the orifice began to bleed afresh, and as she lived in the country, the loss of blood was so great before she could get proper assistance, that she was very much enfeebled and extremely faint. The next day she continued to be weak and languid, the stomach rejected every thing, and generally almost as soon as taken down. She continued in this state for two days, and on the third I first saw her. The effervescing draughts gave immediate relief, the sickness and reachings

reachings ceased, the food was retained, and she soon gained strength.

I have frequently directed Fixed Air in GOUTY affections of the stomach. In some instances it has removed the spasms, and thrown the disease upon the extremities; in others, it has afforded no sensible relief.

The good effects of this medicine in the sickness and vomitings which frequently occur in Fevers, are universally known. The *Formula* however which is directed by Boerhaave, is very different from that which was originally directed by Riverius. The following is Boerhaave's prescription :

R. *Succi recentis citrei unc. fs. Vin. Rhenani unc. j. bene mistis adde salis absinthii drach. j. In ipso actu effervescentiæ potentur. (x)*

(x) *Materia Medica. ad nauseam febrilem.*

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The *formula*, as it stands in Riverius, is this. *Salis absinthii scrupulus unus cum succi Limonum cochleari mixtus, remedium est præstantissimum, præsertim in vomitu qui febribus malignis solet contingere. (y)*

The exceptions to Boerhaave's prescription are, that the citron juice is a weaker acid than that of the lemon, and that the alkaline salt is directed in a much greater quantity than is necessary to saturate the acid; consequently there will be a large portion of superabundant alkali, which will aggravate rather than relieve the febrile symptoms.

SECTION VIII.

On the Use of Fixed Air in the Stone, Gravel, &c.

1. An accurate and ingenious philosopher, the Hon. Henry Cavendish, has pointed out, by a connected train of experiments, that calcareous earths are
made

made soluble in water, by being united with more than their natural proportion of Fixed Air. (y) A writer of eminence, however, doubts whether this conclusion be clearly established. "Notwithstanding this great authority, I hope I may be pardoned if I presume to dissent, as I acknowledge that gentleman's experiments, in order to prove this, though highly worthy attention, did not appear clearly to lead to that conclusion." (z) Some degree of address indeed is necessary, satisfactorily to repeat the experiments of Mr. Cavendish. But there are two very easy experiments, which are conclusive on this subject, and which fully prove that the theory of Mr. Cavendish, is as true as it is ingenious. Let any one blow through a glass tube into a small quantity of lime water; the lime water becomes turbid by the admixture with the

(y) Philosoph. Transac. vol. 57, part 1, article 11.

(z) Falconer's Essay on Bath waters, vol. 1, p. 158.

Fixed Air from the lungs, and the calcareous earth is precipitated from the water, by being combined with *this proportion* of Fixed Air. Continue to blow in the same manner for sometime longer, and the water will by degrees become perfectly clear, the calcareous earth being redissolved by a still *larger proportion* of Fixed Air. Or, put a spoonful or two of lime water, into the middle glass of Dr. Nooth's *apparatus*, already nearly filled with common water, and then let continued streams of Fixed Air be thrown into the water. The water will first become milky, and afterwards perfectly transparent. A small proportion of lime water is here used, that the effect may be the sooner observed; for was the middle glass to be filled with lime water only, a length of time would be necessary to complete the experiment.

2. This doctrine of the solution of calcareous earths, naturally suggested the

the idea of the solubility of the human *calculus* while yet in the bladder, by the regular and continued use of Fixed Air. Dr. Saunders and Dr. Percival first inculcated this opinion; and the first of these gentlemen pointed out, that the diminution of *calculi* on being put into fermenting mixtures, as observed by Dr. Hales, was effected by the Fixed Air generated in these mixtures. The diminution likewise of some *calculi*, by being immersed and macerated in water impregnated with Fixed Air, has been proved by the experiments of Doctors Saunders, Percival, and Falconer.

3. The next point to be ascertained on this subject, is, whether this fluid may be so transmitted by the course of the circulation, as to enter the bladder unchanged, and the urine be thus sufficiently medicated with Fixed Air? “It might be questioned, says Dr. Priestley, whether the Fixed Air contained in our aliments can be conveyed by the course

of circulation into the blood, and by that means impregnate the urine. I have found, however, that it may do it; having more than once expelled from a quantity of fresh-made urine, by means of heat, about one-fifth of its bulk of pure Fixed Air, as appeared by its precipitating lime from lime-water, and being almost wholly absorbed by water; and yet a very good air-pump did not discover that it contained any air at all." (a) That the urine may be still more copiously impregnated with Fixed Air, appears from the following fact related by Dr. Percival. "A young gentleman, Mr. Thomas Smith, has, at my desire, taken large quantities of mephitic water daily, during the space of a fortnight. And whilst he continued this course, his urine was strongly impregnated with Fixed Air, as appear'd from the precipitation which it produced in lime-water; from the bubbles which

(a) Exper. and Observat. on Air, vol: 2, p. 216.

it copiously emitted when placed under the receiver of an air-pump ; and from the solution of several urinary stones, which were immersed in it." (b)

The observations of practical writers, concerning the efficacy of those mineral waters which contain a volatile principle, in calculous cases, is a further argument in favour of this doctrine. That Fixed Air constitutes the volatile principle in mineral waters, is an idea which is now very generally received, and has indeed been clearly ascertained by several authors. (c) Dr. Brownrigg, a faithful and judicious observer, discovered above forty years ago, " that there is in some mineral waters, a particular kind of air, or permanently elastic fluid ; that it is this fluid which enters the composition of the waters of Pyrmont, Spa, and of all others which,

(b) Essays Medic. and Experimental, vol. 3, p. 229.

(c) Page the 7th of this Commentary,

from their sharp and pungent taste, are called *acidulæ*; and that it constitutes the volatile principle of these waters, called their spirit, on which their prime virtues chiefly depend.” (d)

The German Spa waters are recommended by Hoffman, in the stone, and in ulcers and all painful affections of the urinary passages. (e) And Henr. ab Heer says, that by drinking these waters, the *calculi* are voided soft and friable. *Molles inde calculi et friables minguntur.* (f) The *acidulæ* in general, are extolled not only by Hoffman, but by many of the German writers, as efficacious both in preventing and dissolving the stone.

It would be superfluous to introduce a train of authorities, or to enumerate

(d) Philos. Transf. for 1765, artic. 26.

(e) Fred. Hoff. Op. Tom. v. p. 146.

(f) Spadacrene, p. 79.

a variety of these waters; I shall only mention the *Carolinæ* which are of this class, and which abound with Fixed Air. Springsfeld, who wrote on this subject in the year 1756, observed, that the human *calculus*, by being macerated in these waters, was considerably diminished; that the *calculus* was likewise diminished, by being immersed in the urine of those who drank the waters; while the urine of a healthy man, who was not drinking these or similar waters, added to the bulk of the *calculus*. *Calculus humanum, si in his aquis maceretur, minuunt insigniter; hoc calculis renum et vesicæ accidit, non tantum in Thermarum aqua, verum etiam in urina illorum, qui Thermas potabant; cum urina sani hominis, qui has vel similes aquas non potet, calculus immersum augeat. (g)*

4. Mild and sound malt liquor is

(g) *De Prærogat. Therm. Carolin. in dissolvendo calculo vesicæ præ aqua calcis vivæ. Lipsiæ. 1756.*

considerably

considerably impregnated with Fixed Air, and has been recommended both as a preservative, and as affording relief to those who are afflicted with the stone. Cyprian, a celebrated lithotomist, was a very sanguine advocate in favour of malt liquor. Of fourteen hundred patients, whom he had cut for the stone, there was not one whose common drink had been malt liquor. I shall give the reader the passage, as it stands in *Allen's Synopsis*, and quoted from *Catherwood*. D. Cyprianus, lithotomus celeberrimus, inter 1400, quibus operationem celebravit, oinopolas quam plures, sed ne unum quidem zythopolam calculosum invenit. (b) There may be some foundation for this prejudice of Cyprian, but he must certainly be mistaken, when he recommends malt liquor as so universal a preservative.

The attentive and judicious Syden-

(b) *Synopsis*, art. 747.

ham,

ham, who suffered much himself from the stone, is a more guarded and satisfactory evidence on this head. “ To prevent bloody urine from the stone, whenever I am obliged to go very far in my coach on the stones (for the longest journey in unpaved road does me not the least hurt) I always drink a large draught of small-beer before I set out, and another in the way, if I am abroad a considerable time; by which means I secure myself pretty well from bloody urine. A draught of small-beer serves me instead of a supper; and I drink another draught after I am in bed, and about to compose myself to sleep, in order to cool the hot and acrid humours lodged in the kidneys, which breed the stone.” (*i*)

5. After thus enumerating a variety of facts and observations in favour of Fixed Air, as a preservative, a pallia-

(*i*) Swan's Sydenham, p. 535.

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tive;

tive, or a solvent of the stone; I shall briefly mention, the result of my own experience, concerning the use of this fluid in diseases of the urinary passages, whether gravel, stone, abscess, or erosion. In two cases of abscess in the kidney, accompanied with great pain, hectic, wasting, and discharge of *pus*, I have had the pleasure to observe the good effects of Fixed Air, in alleviating the pains, abating the hectic, and forwarding the cure. In some few instances of erosion, I have likewise experienced the good effects of Fixed Air. In the gravel, I have met with many proofs of its efficacy, and am happy to find my own experience confirmed by the following extract of a letter from Mr. Dawson, of Sedbergh, to my friend Dr. Haygarth :

“ Ben. Westley (for whom you formerly prescribed when afflicted with an ischuria) is generally much distressed
with

with the gravel, of which he passes large quantities, and frequently mixed with blood. It is of a very loose texture, and easily crumbles by pressing it with the fingers. Water, impregnated with Fixed Air, entirely dissolved the stony part, leaving nothing but a soft mucus. Encouraged by this experiment, I made him drink the mephitic water, which relieved him pretty much by the time he had used four or five bottles. This method he has tried several times, and always with the same success. This is the only instance in this complaint, where I have made any trial of it."

With respect to the stone, I have had very little, and no decisive experience, of the effects of Fixed Air. It may be asked, whether any one case has yet occurred, in which a stone in the bladder has been totally dissolved by the administration of this remedy? No such case, I apprehend, has hitherto occur-

red. A very flattering one indeed, fell under the care of Dr. Hulme, of the Charter-house. In this patient, the stone appears to have been of a texture favourable for solution, a great number of calculous fragments were evacuated soon after he began the use of Fixed Air, and he was in a few weeks so free from complaints, that the cure was supposed to have been completed. The old pensioner however is since dead, and Dr. Hulme has favoured me with the following ingenuous narrative of the appearances on dissection.

“ It is very true that our Charter-house patient is dead. He was seized with a total suppression of urine, and the obstruction was so great as to prevent the introduction of the catheter, and to elude all other means of relief. On opening the body, the immediate cause of the obstruction was found to be an enlargement of the prostate-gland.

gland. All the urinary passages were free and open, (except what was caused by the pressure of the prostate) no *calculus* being found either in the kidneys, ureters, or urethra. When the bladder was opened and exposed to view, a good many small *calculi* were found of various sizes, and some broken into very small fragments, so as to have passed the neck of the bladder very easily, had there not been an obstruction from the pressure of the enlarged prostate. The large-sized *calculi* had rough surfaces, and various ridges or eminent lines running upon them, so that there was not the least evident sign of their being broken down by trituration, or rubbing against each other; as in that case I imagined they would have put on a smooth surface. Hence the appearances of the *calculi*, in this subject, rather make in favour of a solution having taken place, and been continued, than the contrary. It is also pretty clear

clear from the dissection, that the stone was no cause of the patient's death. The patient remained perfectly free from all symptoms of the stone, for many months before his death, which I can hardly tell how to account for, unless the enlargement of the prostate (for some preceding months) had caused such a strong pressure round the urethra, as to prevent any calculous fragments from passing the neck of the bladder, or entering into the urinary canal: for, as I have said above, there were a great many of them so small as to have easily passed through any urethra in a sound and open state. From all which circumstances, I am rather inclined to think, if this patient had lived, and not had a morbid urethra, that the *calculi* would have been gradually evacuated, either in fragments, or in the form of a cretaceous sediment, and that he would have received a perfect cure."

“ Our

“ Our expectations, adds Dr. Hulme, of the efficacy of Fixed Air, in calculous cases, may perhaps have been too sanguine; but as yet the experiments have not certainly been sufficient to determine the matter: let us not despair too soon, but pursue the idea for some time. Though many *calculi* may be of so flinty a nature, or so circumstanced, as not to yield to this kind of remedy, yet it may succeed in some other cases; one of which, I think, I have under my care at present. This patient had laboured under symptoms of the stone for some years, and had taken various things without success. Among other symptoms common to this disease, he had the sensation of a large heavy weight in the bladder, which on making a false step, &c. gave him much jarring pain; he made but a small quantity of urine at a time, and that with great uneasiness. He was searched, and a stone found. He applied to me, and I ordered

I ordered him the alkali and acid, to be taken separately, as mentioned in my publication. It had no effect on him for the first two or three weeks; he afterwards began to void, every day with his urine, a quantity of brown or whitish calculous sediment, which he has continued to do for some months past, and still pursues the same plan. The symptoms are greatly diminished, he can retain his urine much longer, makes it in a larger stream, and the stone sits light and easy in the bladder, and according to the patient's sensation and opinion, is reduced to a small size. Whether the medicines will have sufficient power to act upon the nucleus, or remainder of the stone, and bring it entirely away, time alone must discover."

Upon the whole, the sedative and solvent powers of Fixed Air, in cases of the stone, are so far ascertained, as to give it a claim to the particular attention

tention of the faculty. Further experience can alone determine, whether by the steady and long continued use of this medicine, a cure may not in some instances be happily effected: and it is no inconsiderable recommendation, that the medicine is pleasant, safe, and even friendly to the constitution; and that it will relieve the painful symptoms, though it should not produce a complete solution of the *calculus*.

6. With respect to the method of administering Fixed Air in cases of the Stone, the following I apprehend will be found to be the most easy and powerful. Let the patient take three times a day, an ounce of the *aqua mephitica alkalina*, containing one scruple of alkaline salt, saturated with Fixed Air according to the directions of Mr. Bewley, (*k*) and sweetened with a little honey: let him wash this down with half

(*k*) Priestley on Air, vol. 2d, p. 345.

an ounce or a large spoonful of lemon-juice, made into lemonade. The patient thus takes, not only the common proportion of Fixed Air contained in the alkaline salt, but likewise that which has been superadded to saturate or neutralize it. The common drink of the patient should be, mephitic water, *wort* sweetened with honey provided it sits easy and agrees with the stomach, mead, or sound malt liquor. Cask-ale I think is preferable to that which is kept in bottles, on this account, the Fixed Air is in a more quiescent state, is not lost in eructations from the *primæ viæ*, and is consequently conveyed in a larger proportion to the kidneys and bladder. Honey may be eaten at pleasure, as perfectly coinciding with the intentions of the medicine ; and where it suits the constitution, may be used to the quantity of a pound or a pound and a quarter every week, as recommended by Sir John Pringle.

By

By this method, the urine will be well impregnated with a constant and copious supply of Fixed Air; more so indeed, than by immediately injecting the mephitic water into the bladder. For the supply by injection, would be irregular and inadequate, the operation being attended with so much pain and inconvenience, as to prevent its uniform and frequent repetition; and when conveyed into the bladder, the irritation, from sudden distention, would be such, as often to occasion its being rejected.

Before the patient begins his course, it is a good precaution, to examine the stony sediment of the urine, or any calculous fragments which are passed, by putting them to the test of Fixed Air. This will determine, as Doctor Ambrose Dawson judiciously observes, whether the calculus is of such a nature, as to be soluble in the medicine which is proposed. (*l*)

(*l*) Medical Transactions, vol. 2, p. 119.

Some *calculi* abound so much with *mucus*, as to elude the action of Fixed Air. In such cases, the alternately exhibiting the caustic alkali and Fixed Air, as recommended by Dr. Saunders, will facilitate the solution.

SECTION IX.

On the disposition to the stone in the cyder counties, compared with some other parts of England.

Whether the stone is a rare or frequent disease in countries where the general beverage abounds with Fixed Air, is a question which can alone be determined by a faithful narrative of facts. Solicitous to throw further light on a subject, in which too many of my fellow creatures are interested, and to contribute by every possible means, to remove or at least mitigate the pains of this dreadful disease, I have been at some trouble to collect a comparative

comparative view of the disposition to the stone in several parts of the kingdom. My design was, to ascertain the number of patients who had been cut for the stone, in the several hospitals to which I applied, compared with the whole number of both in and out patients; and likewise, whether there was any thing peculiar in the food, drink, or situation of the inhabitants of the respective districts. After returning my sincere thanks to those gentlemen, who have given me information on these heads, I shall proceed to lay before the reader the result of this inquiry.

§ 1. *Newcastle*. The hospital here, is for the town of Newcastle, and the counties of Durham and Northumberland. Out of 26,619 patients, 93 have been cut for the stone; or 1 in 287. “The lower people in general, Mr. Lambert informs me, work hard and live well; in the towns, as the same rank

rank usually live in towns ; their drink, a well-brewed and well-hopped malt liquor, without so much tippling in spirits as in many other of the seaports. The farmers and labourers live much after the same manner as such people do in all the northern counties. As to calculous patients, we have never observed more admitted from one district than another, having been equally received at the hospital from all quarters within the limits of its circuit." The water in common use at Newcastle, is taken from the river Tyne. This water has been accurately examined by Dr. Rotheram, and found to be soft and pure. (*m*)

§ 2. *York*. In this hospital, 50 have been cut for the stone, out of 23,735, or 1 in 474. " The lower class of people, says Dr. Hunter, drink their malt liquor remarkably new ; and as far as

(*m*) *Philos. Inq. into the nature and properties of water.*

I can learn, the river water running over an ouzy bed, is used for all domestic purposes."

§ 3. *Leeds*. In the Leeds hospital, out of 7,851 patients, 23 have been cut, or 1 in 340. Of this number, seven came from the township and four from the parish of Leeds, the rest came from a distance. The township of Leeds contains above 17,000 inhabitants, and the parish is supposed to contain about the same number. Mr. Lucas further observes, "that the common drink of the town and neighbourhood, is malt liquor, which is chiefly supplied by three common breweries, all of which are soft water. The town is served from the river with soft water; the springs in general afford hard water."

§ 4. *Manchester*. Mr. White informs me, that in the Manchester hospital, 62 patients have been cut for the stone,
out

out of 34,565, or 1 in 557. Of this number, 12 were from the town of Manchester, 8 from Sheffield, 4 from Halifax, 3 from Congleton, 3 from Ashton, 3 from Wigan, 2 from Derby, 2 from Bolton, 2 from Bury, 2 from Rochdale, 2 from Lancaster, 1 from Chester; and the rest were country patients, from a circuit of considerable extent. It is to be observed, that the pump waters of Manchester are remarkably hard; (*n*) and yet this town has sent only 12 stone patients to the hospital, during a course of 26 years; while Sheffield, which Mr. Wooffendale informs me, is wholly supplied with very soft water from an open reservoir at some distance from the town, has in six years sent 8 patients to the Manchester hospital.

§ 5. *Liverpool*. It appears from the Manchester report, that the stone is

(*n*) Percival's Essays, vol. 1, p. 344.

not

not a frequent disease either in the town of Manchester or the eastern parts of Lancashire; and I know from the experience and observations of twenty years, that it is still a much less frequent disease in Liverpool and the western parts of Lancashire. Of 26,073 hospital patients at Liverpool, only six have been cut for the stone; or 1 in 4,345. The common drink of the lower people in this county, is water, milk and water, butter-milk, small-beer, or ale. The spring water of Liverpool, which is for table use, is tolerably pure; and the springs through the county in general, are often hard.

§ 6. *Chester*. Dr. Haygarth has favoured me with the following information concerning Chester, and its neighbourhood. “ Both from my own observation and very extensive inquiries among the medical practitioners, it appears, that the *calculus vesicæ* is a very

uncommon disease in North Wales. In the whole district, for the last twelve years, I cannot learn that more than one patient has been cut, and that six, supposed to be afflicted with the stone, have died without submitting to the operation. In Cheshire, my medical connections and inquiries, comprehend the western half of the county; in which I have been informed, that in the course of the last twelve years, five have been cut, and two have died uncut.

“ The Chester infirmary is the receptacle of the diseased poor from the districts above described. Of 12,334 in and out patients, admitted since its establishment, only one has been cut for the stone; nor can I learn that another calculous case ever offered, though in this instance the operation was performed successfully, and though our surgeons are justly celebrated for their skill and dexterity.” If to the patient here mentioned, be added another

ther Chester patient who was cut at the Manchester hospital in the year 1763, before Dr. Haygarth was fixed at Chester, the proportion will be 2 in 12,334, or 1 in 6,167.

“ At Chester, continues Dr. Haygarth, the very lowest class of people, drink a kind of fermented liquor. At our sugar-houses, the molds in which the sugar is refined, are immersed in water, to dissolve what adheres to them, after the loaf is taken out. The water having served this purpose for a week, is impregnated with sugar, and sold under the denomination of *sweet water*, at the rate of six gallons for a penny; so that the very poorest may purchase it. This liquor fermented with yeast, is drank as small-beer; and 844 gallons are consumed every week. It is not so pleasant however, but that many prefer milk or even water.

“ Both in North Wales and Cheshire,

the lowest class universally drink water or milk, chiefly butter-milk. But the farmers of all denominations have malt liquor in their houses, generally ale. All classes, both in town and country, get ale occasionally at the public-houses. Tea, which renders water more diuretic, is drank every where.---I know of no liquor, that so manifestly occasions nephritic symptoms, as old stale strong beer.

“ Chester is so plentifully supplied with water from the Dee, that river water is most generally used for domestic purposes by all the inhabitants; however both spring and pump water are occasionally drank. I have evaporated to driness, by a gentle heat, not exceeding 100° , these different kinds of water; and found in a gallon of the Dee water, a *residuum* of 7 grains; of a favourite spring, called Barrel-well, 15 grains;

grains ; and of each of the other springs, from 60 to 80 grains."

§ 7. *Shrewsbury*. In the hospital here, 8 patients have been cut for the stone, out of 13,167, or 1 in 1,646. "Cyder, Dr. Owen informs me, is but little used among the inferior mechanics and peasants of this country. The very small quantity they consume, is miserable, crude, austere stuff, the produce of our own county, but too inconsiderable in quantity to be admitted as the ground of any conclusion, respecting its power of generating calculous concretions. Their beverage is almost entirely small-beer or ale. Their bread is composed chiefly of a certain proportion of wheat and rye, which is light and well fermented ; and they live well on a due proportion of animal and vegetable food. On the whole, you will conclude, that I can draw no practical inference respecting the occasional cause of the stone in this part of the kingdom."

Of

Of the 8 patients mentioned by Dr. Owen, 1 was from the town of Shrewsbury, 4 from the county of Salop, 2 from Staffordshire, and 1 from the county of Montgomery.

§ 8. *Leicester.* “ Our infirmary, says Dr. Vaughan, was opened in the year 1771, since which time 1,912 persons have been admitted in and out patients. Of this number, three only have undergone the operation of lithotomy; and one man, who died of a chronic disease, without any symptom of a stone during his life time, was found to have one after his death, of the weight of two ounces, and the surface of it very rugged. I am not acquainted with any particular district, where the inhabitants are more than usually afflicted with the disease; nor am I aware that any particular kind of diet has contributed to the formation of so terrible a malady: but let me at the same time acknowledge,

knowledge, I have not in this respect paid particular attention."

Of 1,912 patients therefore in the Leicester infirmary, 4 have been afflicted with the stone, or 1 in 478.

§ 9. *Gloucester*. From the first institution of this hospital, in the year 1755, 21 patients have been cut for the stone, out of 12,490, or 1 in 594. Mr. Cheston has favoured me with the following information. " Since Nov. 1771, I have cut eleven patients in our hospital for the stone, eight of whom have been of different ages, from 4 to 12, one about 17, another 19, and a third about 25. But not one of these could I am sure, from their situation, as well as the parts of the county they came from, have ever been in the way of drinking cyder for their common liquor. My colleague, Mr. Crump, has cut two who may be considered in the same light.

From

“ From a particular review of the parishes in the neighbourhood of this city, where there is the largest growth of apples or pears, the *true calculus* is certainly an uncommon disease; for tho’ the stone and gravel, as it is commonly called, may be frequently complained of by many people, it is in too indiscriminate a manner to be worth attention; and the real cause of such complaints almost always proceeds from an indisposition of the bladder, or that discharge of small sandy particles, which rarely are concreted together of any size, and consequently not the object of your enquiry.

“ Within a few miles of this city are made different sorts of perry; one of which, from the common suffrages of the people, is reckoned particularly serviceable in the gravel. The fruit it is made from, bears the name of Barland-pears, and the juice is certainly very diuretic,

diuretic, of an austere astringent taste, and very inebriating. Whether its effects may be attributed to any peculiarly stimulating quality, or to the large portion of Fixed Air it may contain, is not in my power at present to determine."

In a subsequent letter, Mr. Cheston further observes, that "The drink of the common people in the cyder counties is in general a weak cyder, made by adding water to the cakes of the apples, after the prime juice has been extracted from them. This mixture is again ground, and committed to the press a second time; and having afterwards undergone a considerable degree of fermentation, is frequently made use of in a fortnight or three weeks after it has been in the cask, when it drinks brisk, and will at first sparkle in the glass, but if kept any time becomes vapid, harsh, and at last sour.

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“ In the farm houses most of the cyder drank by the family in the early part of the season, is of this kind ; and when this is exhausted they proceed to the liquor made from the inferior fruits, which is less diluted for the purpose of keeping the better. It is however impossible to determine, with any degree of certainty, the quality of these different liquors, as the state of the fruit when ground, the plentifulness of the season, and the attention to the fermentation afterwards, ever make a variation in the quality, and of course in the effect, of this beverage. But no doubt can be made that they contain a considerable portion of Fixed Air, which they do not readily part with, if the fermentation in the cask is not suffered to proceed so far as to become acetous. This is prevented by repeated rackings.

“ Being anxious for the reasons assigned

signed in my last to extend my inquiries, particularly to the Barland perry, I with some difficulty got different specimens of it; but found that, like other perry, it was very prone to fermentation, and therefore contained more or less Fixed Air in proportion as this circumstance, by proper care, had been regulated and conquered. In no other respect but the austere taste, did it seem essentially to differ from other perry."

Mr. Cheston concludes with the following pertinent query: "Does not the difference in the number cut at the different hospitals, in your narrative, depend more on the character of the surgeons, or their inclination for the operation, than any provincial cause? At a county hospital, which has been established some years, I have been assured, no stone patient was cut till lately; all that offered being recommended to London." The circumstance

here pointed out, has been particularly attended to through the whole of this inquiry.

§ 10. *Worcester*. During the last twelve years, 25 patients have been cut in this hospital, out of 7,752, or 1 in 310. Of this number, sixteen were cut by Mr. Russell, and nine fell under the care of the other surgeons. “ I do not recollect, says Mr. Russell, that any one of those cut here, came out of Herefordshire, and believe the disease is less frequent there, than in this or the neighbouring counties. It is however rather a vulgar error, which has pretty generally prevailed, to suppose that cyder drinkers never have the stone in the bladder. A few years ago I was called to a man, aged 68, who during his whole life scarcely ever tasted any other liquor than cyder ; but upon passing a sound into his bladder, I found a *very large* stone indeed. I know a farmer,

mer, a few miles from Worcester, upwards of seventy, who from his childhood till lately has drank chiefly cyder and perry for his common drink. He finds rather less pain when he drinks fresh malt liquor; and he has a considerable stone or stones in his bladder.

“ In consequence of Dr. Hulme’s first publication, I have ever since recommended to my nephritic patients the sal. tartar and spirit. vitriol. ten. agreeable to his directions; and I think most, nay all of them (which have not been a few) have at least for a while, found an abatement of their pain. Some have persisted in taking it constantly for many weeks, others only from time to time, but not one has received a cure, nor has it appeared by the urine that there was the least reason to hope a dissolution of any part of the stone had taken place. In Herefordshire, I believe

lieve nephritic complaints are less frequent than in this county."

§ 11. *Hereford.* The hospital here, Dr. Cam informs me, "is a temporary building of not three years standing, and makes only 25 beds. The number of in and out patients does not exceed 798, and I do not find one who has been afflicted with the stone."

§ 12. *Exeter.* In the Devon and Exeter hospital, 75 patients have been cut, out of 26,606, or 1 in 355. "I shall with pleasure, says Dr. Glass, give you the best intelligence I can, with respect to the fact you wish to have ascertained. In the county of Devon, the stone and gravel are common diseases among the lower classes of people; but whether our people are more or less subject to these diseases, than the inhabitants of other counties who drink no cyder, I cannot pretend to say. It was you
know

know Sydenham's opinion, that small-beer drank plentifully, prevented the growth of the stone in the kidneys; and I imagine there is more Fixed Air in beer than cyder, at the end of fermentation."

If we take the medium of the reports of the Gloucester, Worcester, Hereford, and Exeter hospitals, a circle in which more cyder is drank than in any other part of the kingdom, and which may therefore properly be called the cyder district, the proportion of those who have been cut for the stone, to the whole number of patients from all other diseases, is 121 in 47,646, or 1 in 394.

I shall only mention the reports of two other counties, on the south-east or opposite side of the kingdom; the two adjoining counties of Cambridge and Norfolk.

13. *Cambridge.*

§ 13. *Cambridge*. “ Out of 6,600 in and out patients, says Dr. Collignon, admitted on our books, only four have been cut for the stone, or 1 in 1,650. Malt liquor is the entire liquor of our poor, and except in the heat of the harvest months, the small-beer is generally very new. The water in this place and neighbourhood is not any ways remarkable for hardness or softness, compared I mean with many others; though the incrusting tea-kettles, turning greenish when poured on violets, and becoming turbid with a solution of *saccharum saturni*, are impeachments of its purity.”

§ 14. *Norwich*. In the Norwich and Norfolk hospital, 55 have been cut, out of 3,016, or 1 in 55. An astonishingly great proportion indeed.---I learn from Dr. Manning, that 17 of the above 55 stone patients belonged to the town of Norwich. “ The pump water,
says

says the Doctor, in general use here for drinking, &c. does not lather with soap, but is hard, and considerably incrusts tea-kettles. The river water, which is in common culinary use, is soft and lathers easily with soap. I know of no particular district, which has furnished more than its proportion of stone patients; nor of any particularity in the diet or drink of such as have been admitted into the hospital. The bread of Norfolk is wheat; and the beverage beer, generally new and often acid. There is not much to be expected from the history of different districts in Norfolk. The basis of our county is chalk, and the surface a flint sand or gravel, mixed with a small portion of clay and tinged with ochre. The most *stupendous* of our *mountains* may be 40 or 50 feet high."

General Observations and Queries.

I. It appears that the stone in the
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bladder is not an uncommon disease among the lower class of people in the cyder district; more common indeed, than in several other parts of the kingdom, in which malt-liquor is the general beverage. It has already been observed, that the number of stone patients cut in the respective hospitals, may vary, according to the celebrity of the operators or the inclination to operate. This objection however loses the greatest part of its weight, by taking the *medium* report of a number of hospitals, and in a wide extended circle. In the Gloucester, Worcester, Hereford, and Exeter hospitals, 121 patients have been cut for the stone, out of 47,646, or 1 in 394. The report of the North East part of England, including the hospitals of Newcastle, York, Leeds, and Manchester, shows that 228 have been cut, out of 95,770 patients, or 1 in 420. The report of the North West part of England, comprehending the hospitals

hospitals of Liverpool, Chester, Shrewsbury, and the whole of North Wales, mentions 16 patients who have undergone the operation, out of 51,574, or 1 in 3,223. The stone therefore is a more common disease in the cyder district, than in North Wales and the North of England.

II. This inquiry confirms the general opinion, that those liquors which are hard and contain a crude acid, are prejudicial to constitutions which have a disposition to the stone. The cyder drank by the poorer people, as remarked by Mr. Cheston, is weak, contains little Fixed Air, but a large proportion of crude acid, the product of a partial acetous fermentation. (o) The report likewise of the Norwich and Norfolk hospital, gives by far the greatest number of stone patients; and Doctor Manning observes, that the beer is ge-

(o) Page 161 of this Commentary.

nerally new and often acid. (*p*) This cause alone, however, does not appear adequate to the effect; further experience and observation therefore must determine, whether this remarkable prevalence of the stone in the county of Norfolk, be uniform, how far it is to be attributed to the drink in common use, or what other causes may concur.

III. Taking in the whole of the preceding reports, it appears probable, that hard waters rather prevent than contribute to the formation of the stone. This conclusion is also confirmed by the observations of practical writers, who have recommended the waters of Buxton, Matlock, Bath, Bristol, and a number of other hard waters, containing a considerable proportion of earth, to patients afflicted with the stone and gravel. To this general observation, however, of the utility of hard waters

(*p*) Page 169 of this Commentary.

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in calculous constitutions, some exceptions may occur, and in these cases, strict attention is to be paid to peculiarity of constitution.

IV. The stone is a disease which prevails much more in certain districts than in others. This is evident from recurring to the particulars of observation Ist, and from comparing the reports of the two counties of Norfolk and Cambridge. (*q*) It is likewise to be observed, that the great disproportion in the disposition to the stone, not only in separate hospitals, but in whole districts, cannot satisfactorily be accounted for, by any external circumstances hitherto discovered, respecting either food, drink or situation.

V. Are we not hence led to consider the stone sometimes as a disease of the constitution? Is it not in some instances

(*q*) Page 168 of this Commentary.

rather

rather an animal production, than proceeding from stony matter introduced *ab extra*, and afterwards collected and concreted in the kidneys or bladder? And is not this idea confirmed, by the following arguments from analogy?

1. If the animal earth be supplied *ab extra*, and conveyed into the system with the food or drink in the form of earth, it ought to be found of the same nature in whatever part of the body it is detected. We learn however from the experiments of a justly celebrated chemist, Dr. Lewis, that the animal earth is different according to the different parts of the animal from which it is obtained, and also according to the difference of *mode* by which it is obtained. The earth of the *shells of sea-fishes*, is by calcination changed into quick-lime; and is of the same nature with chalk, and the mineral calcareous earths: is readily soluble in the nitrous, marine, and

and vegetable acids, but very inconsiderably in the vitriolic. The earth of *bones* and *horns* procured by fire, is soluble in the nitrous, marine, and vegetable acids, but not in the vitriolic; it is not convertible into quick-lime, for however strongly calcined, it remains insipid, and gives no manifest impregnation to water. The earth of *blood*, *skin*, and *flesh*, obtained in the same manner, is soluble in the vitriolic as well as the other acids, and is not convertible into quick-lime. The earth again into which animal substances are resolved by putrefaction, is one and the same from whatever subject it be procured; and does not sensibly differ from vegetable mould. (r) The animal earth therefore is less elementary than is commonly imagined, and receives its different characters from the various combinations and new modifications

(r) Neumann's Chem. translated by Lewis, p. 493, n. 1, 2 and 3.

which

which it undergoes in the animal œconomy. “ We have no where, says an excellent philosopher, more striking examples of the conversion of matter into new forms, than in the bodies of animals; changes effected by a natural process, which art has attempted in vain to imitate or account for.” (f)

2. The earth which is introduced *ab extra*, by drinking mineral waters or by any other means, is not found either to aggravate calculous complaints, or to encrease the disposition to the stone.

3. The shells of fishes suggest an analogy in support of this doctrine. The oyster, for instance, furnishes by its own peculiar œconomy a large mass of calcareous earth, which serves it for a substantial covering and defence. This mass can with no propriety be supposed to be conveyed into the stomach in the

(f) Neumann, *ibid.* page 481.

form of earth; or that it could thence be transmitted to the surface of the oyster, and there form its shell. It appears evidently to be the product of a peculiar organization: and it is a further confirmation of this reasoning, that in some shell-fish this organic power is exerted only at particular seasons.

4. Another analogy may be deduced from the stony matter which incrusts the teeth of the human species themselves. This may be concluded to be a constitutional disposition, because among a number of persons whose mode of life is the same, some have their teeth almost wholly covered with this stony concrete, the system producing it in astonishing quantities, while others are comparatively free.

VI. If the stone is to be considered in some instances as an animal production, or as a disease of the constitution,

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may we not thence infer, that it is also frequently hereditary? Is not this one reason why the stone is so much more prevalent in some districts than others, and in which there are no external circumstances either in situation or manner of life, by which we can account for the greater or less frequency of the disease?

Such are my present thoughts on this subject. I am far, however, from considering them as clear and conclusive. Other physicians may make different comments, and draw different inferences from the above reports; and a still more extensive collection of facts may produce also a more useful, satisfactory, and decisive theory.

I cannot conclude this section, without expressing a wish, that the hospital reports throughout the kingdom, were drawn up in a more full and circumstantial

stantial manner. The sources and nature of endemics, and of some other diseases also with which we are at present but obscurely acquainted, might be thus more clearly ascertained, and a more successful method of cure consequently adopted.

SECTION X.

On the noxious effects of Fixed Air.

In a paper which was written some years ago on the *noxious vapours of charcoal*, and published at the request of my friend Dr. Percival, in the second volume of his *Essays Medical and Experimental*, I endeavoured to point out, that those animals which are killed in the Grotto di Cani, in the cavern of Pyrmont, (*t*) or by the vapours of burning charcoal,

(*t*) To which I may now add the caverns of Schwalbach.---The vapour in all these places, consists principally, if not entirely, of Fixed Air. That in the caverns of Schwalbach possesses the known properties of Fixed Air; it preserves animal substances from putrefaction, and immediately kills all the insects, reptiles, or other animals which it surrounds: *et quod notabile ad-*

charcoal, are not suffocated, according to the opinion of Hoffman, Hales, and Morgagni, but that the vital principle itself is immediately extinguished by the action of these vapours on the brain and nervous system. It appears likewise that the various kinds of Fixed or Factitious Air, act in a similar manner, when so applied as to occasion death.

Suffocation, or the taking away life by a stoppage of respiration, is not an instantaneous but a gradual process. Whereas in those animals which are killed by being immersed in Fixed Air, death is immediate and without struggle. Even flies and other insects, which have

modum, quousque effluvia in aere diffunduntur, muscus, mures, glires, serpentes, bufones, cæciliæ, lacertas, vermes, nullatenus subsistere posse. See p. 88 of this Commentary, et Merian. Topograph. p. 123 & 127. The waters themselves are likewise so strongly impregnated with this vapour, as to kill frogs and fishes of every kind: ranas nimirum, cancos, pisces quoscunque, in his aquis incontinenter mori. ibid. Hence we see the probable utility of Fixed Air in worm cases, as recommended by Dr. Hulme.

have no lungs, and consequently cannot suffer by suffocation, instantly drop down motionless. The effects here are the same with those which are produced by lightning or the electrical shock.

Dr. Hales indeed says, that lightning kills by suffocation, diminishing the elasticity of the air, and making the vesicles of the lungs to collapse so as to cause sudden death. (*u*) But the appearances in those animals which are killed either by lightning or electricity, do not in the least resemble those which are observed in animals killed under an exhausted receiver. An ingenious lecturer on natural philosophy, proposed to show his pupils what strength of an electrical shock would kill a pigeon. The discharge was accordingly made: when, to their great surprise, the bird continued in the same attitude, and appeared not to have suffered the least in-

(*u*) Statical Essays, vol. 1, p. 261.

jury. The lecturer therefore supposed, that by some accident the bird had escaped the shock, and was preparing to discharge another phial. A gentleman however in the mean time putting his hand on the pigeon found it already dead, without any change either in the eyes, the attitude, or the ruffling of a single feather. Lightning is not less instantaneous in its fatal effects than electricity; and when the celebrated professor Richman fell a sacrifice to his philosophical curiosity, and was killed by a flash of lightning conducted by his *apparatus* from the clouds, his dissolution was instantaneous, and he felt no more pain than if he had fallen asleep.

Equally instantaneous are the destructive effects of Fixed Air; and where an animal is exposed to it even in a more dilute tho' yet noxious state, the mischief is still exerted on the brain and
nervous

nervous system, producing a gradual and insensible extinction of the vital principle. Of this I have met with a number of instances, but shall relate only the two following.

Lime kilns throw off large quantities of Fixed Air, and those who incautiously lay themselves down either on the walls of the kiln, or so near as to be exposed to the vapour which rises from the burning lime stone, often experience its pernicious effects. Some years ago, I remember a poor family of this town, which lodged in a room adjoining to a lime kiln; during the night, the vapour of the burning lime made its way into the room, and the four persons of which the family consisted, were all killed. In the morning they were found lying as in a composed sleep, without any appearance of having gone thro' either pain or struggle.

In the Spring of this year, 1778, two disorderly young women, after rambling about the town for a considerable part of the night, crept early in the morning into a little hovel which was contiguous to a lime kiln. The kiln was charged and burning, and the vapour of the lime was forced thro' some crevices into the hovel. After some hours, the man who had the care of the kiln, and who was father to one of the women, came to look after his work, and finding them as he supposed asleep, went away without disturbing them; some time after he returned, and seeing them still in the same place, endeavoured to awaken them, but in vain; they were cold and motionless. In one there did not appear to be the least remains of life; and in the other there was only a slight and indistinct movement about the heart. This patient was soon conveyed to the hospital, and by fomentations applied to the whole body, friction

tion, venesection, blistering, and, as soon as she could swallow, some doses of emetic tartar, she perfectly recovered. The other was not conveyed to the hospital so early, the same means were used, but without success.

When the patient who recovered, was first brought to the hospital, life was only not departed, and the little which remained, was hastening away without the slightest appearance of sensibility. But the return of life, was accompanied with a very painful struggle. She became uneasy, restless, and groaned heavily; she was very hot, the pulse very rapid, and as soon as she could speak, complained much of her head. Within 48 hours, however, of her being brought, she was so well recovered as to run away from the hospital, without expressing the least sense of gratitude for the care and humanity which had been exercised towards her.

The melancholy catastrophe of the elder Pliny, appears to be another instance of the same kind. 'Tis well known, that this distinguished and inquisitive philosopher was deprived of life, by approaching too near Mount Vesuvius, during one of its most tremendous eruptions. The general supposition is, that he was burnt or suffocated; but it is more probable, that life was immediately extinguished, by the breaking forth of a mephitic vapour. The account is related at large by his nephew, the consul; from which I shall transcribe the following extract. “ *Ibi super abjectum linteum recubans, semel atque iterum frigidam poscit, hausitque: deinde flammæ, flammarumque prænuntius odor sulfuris, alios in fugam vertunt, excitant illum. Innixus servis duobus assurrexit, & statim concidit, ut ego colligo, crassiore caligine spiritu obstructo, clausoque stomacho, qui illi natura invalidus & angustus & frequenter intercæsuans erat. Ubi dies redditur, is ab*
eo,

eo, quem novissimè viderat, tertius, corpus inventum est integrum, illæsum, opertumque, ut fuerat indutus : habitus corporis quiescenti quàm defuncto similior.” (x)

I shall likewise give the reader the above passage, in the words of our English Pliny, Mr. Melmoth. “ There my uncle having drank a draught or two of cold water, threw himself down upon a cloth which was spread for him, when immediately the flames, and a strong smell of sulphur, which was the forerunner of them, dispersed the rest of the company, and obliged him to rise. He raised himself up with the assistance of two of his servants, and instantly fell down dead ; suffocated, as I conjecture, by some gross and noxious vapour, having always had weak lungs, and frequently subject to a difficulty of breathing. As soon as it was light again, which was not till the third day

(x) *Plini. Epist. lib. vi. epist. 16, sub finem.*

after this melancholy accident, his body was found entire, and without any marks of violence upon it, exactly in the same posture that he fell, and looking more like a man asleep than dead." (y)

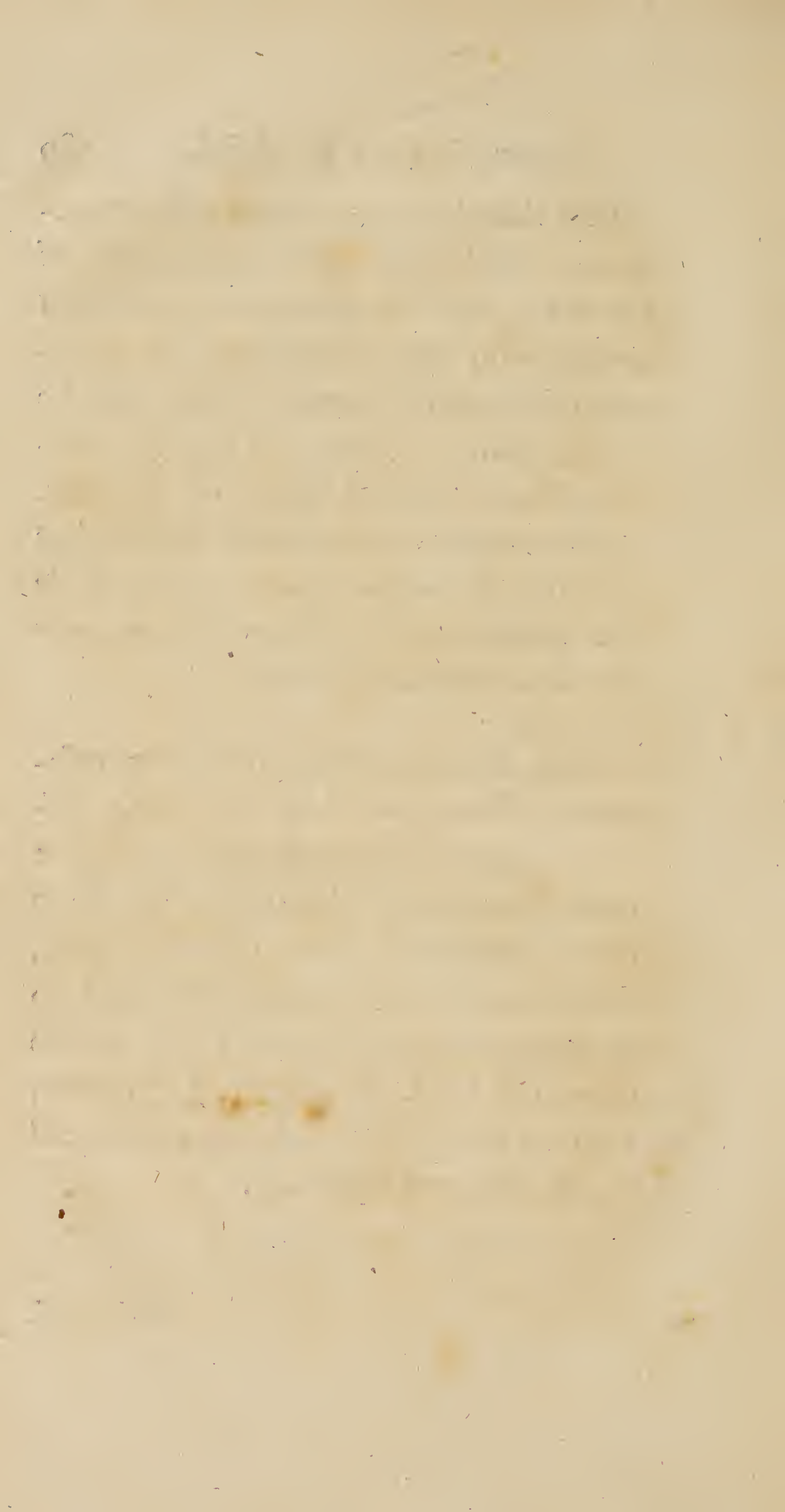
The circumstances which render it probable, that Pliny was killed by a mephitic vapour and not by fire, are the following. The Grotto di Cani, and other places of the same nature, show, that these vapours abound in the neighbourhood of Vesuvius; and they must often, during an eruption, be forced in unusual quantities from the bowels of the earth, by the heavings and convulsive throws of the mountain. These vapours also are heavier than common air, and rest therefore immediately on the ground; and as Pliny was in a recumbent posture, he would be much more exposed to their

(y) The Letters of Pliny, translated by Melmoth.

action

action than his companions and attendants. And lastly, the appearance of the body after death, was not that of a person who had been burnt or suffocated by a sulphureous flame; for he lay like one in whom life had been extinguished without pain or struggle. “ *His body was found entire, and without any marks of violence upon it, exactly in the same posture that he fell, and looking more like a man asleep than dead.*”

Had the attendants of Pliny resolutely carried the body to a little distance, and not left it involved with the poisonous vapour, his life might have been preserved. For those animals, which are become motionless, and to appearance dead, by being put in the Grotto di Cani, or cavern of Pyrmont, recover, on being withdrawn and placed in the free and open air.



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 E R R A T A.

PAGE 128, Omitted the reference (*y*) viz. *Praxis medica. lib. 9. cap. 7. et observationum centuria prima, observ. 15.*

P. 180, l. 1, of the note, for *muscus* read *muscat.*

P. 184, l. 1, for *this* read *the*.



